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Amide Bond Formation Assisted by Vicinal Alkylthio Migration in Enaminones: Metal and CO-Free Synthesis of *α,β*-Unsaturated Amides

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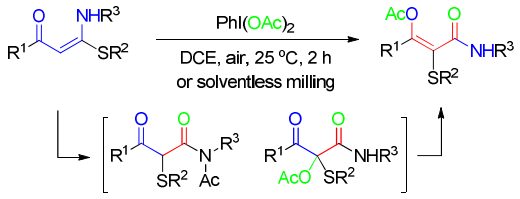
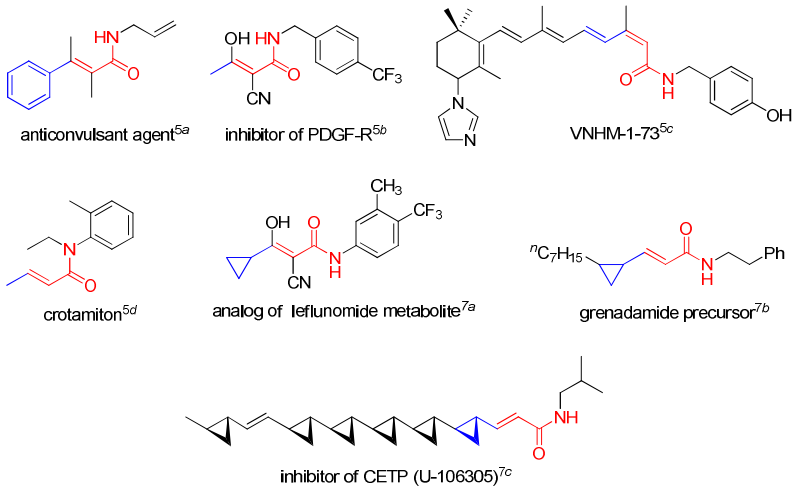


ABSTRACT: Amide bond formation is one of the most important transformations in organic synthesis, drug development, and materials science. Efficient construction of amides has been among the most challenging tasks for organic chemists. Herein, we report a concise methodology for amide bond (-CONH-) formation assisted by vicinal group migration in alkylthio-functionalized enaminones (α-oxo ketene *N*,*S*-acetals) under mild conditions. Simple treatment of such enaminones with $PhI(OAc)_2$ at ambient temperature in air afforded diverse multiply functionalized *α,β*-unsaturated amides including *β*-cyclopropylated acrylamides, in which a wide array of functional groups such as aryl, (hetero)aryl, alkenyl, and alkyl can be conveniently introduced to a ketene moiety. The reaction mechanism was investigated by exploring the origins of the amide oxygen and carbon atoms, isolation and structural characterization of the reaction intermediates. The amide bond formation reactions could also be efficiently performed under solventless mechanical milling conditions.

INTRODUCTION

Amide bond is the basic linkage of peptides and proteins, and also acts as the key functionality in many pharmaceuticals and functional polymeric materials.[1] Amide bond formation has been among the most challenging organic transformations.[2] However, direct condensation of a carboxylic acid and a primary or secondary amine can not form an amide by loss of water as the by-product. The conventional method for chemical formation of an amide bond usually involves activation of a carboxylic acid by an activating (coupling) reagent, and subsequent coupling of the in-situ generated activated form of the carboxylic acid with a free amine through nucleophilic displacement. Without an activator (coupling reagent) the carboxylic acid and amine only form a carboxylate-ammonium salt, instead of an amide, because the reaction thermodynamics is not favorable for amide formation. Although continuous efforts have been devoted to this area,[3] the state of the art in the conventional method for amide bond formation is approaching its inherent limit.[4]

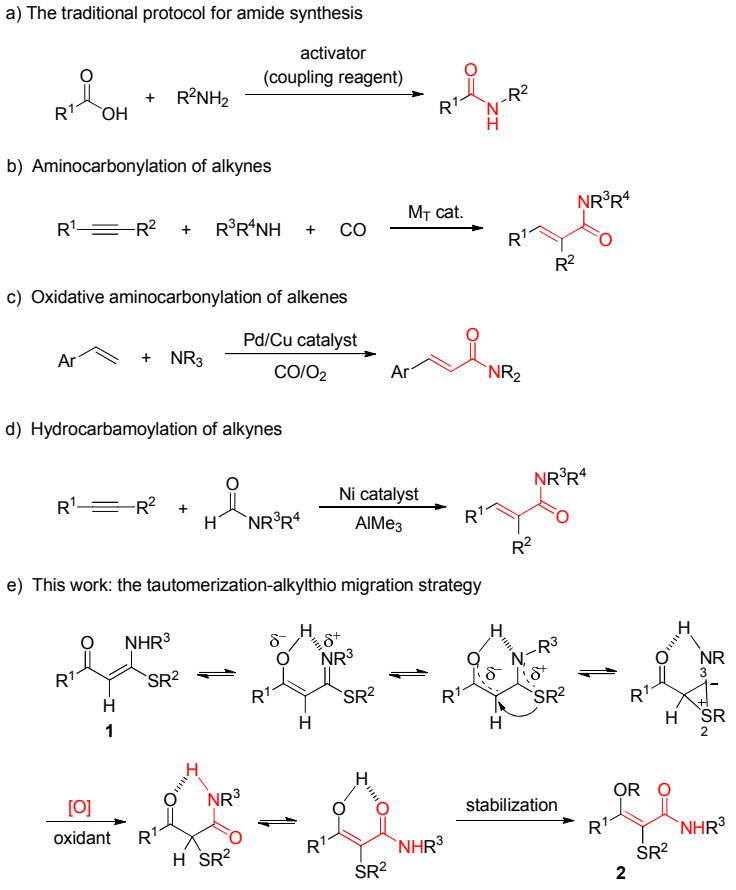
Scheme 1. Selected Pharmaceutical Reagents Containing an *α,β*-Unsaturated Amide Functionality



α,β-Unsaturated amide, that is, acrylamide, is a key structural motif in a variety of natural products and pharmaceutical agents (Scheme 1). For example, (*E*)-*N*-allyl-*α,β*-

dimethylcinnamamide has been pharmaceutically tested as an anticonvulsant agent.[5a] 2-Cyanobut-2-enamide can be used to treat cell proliferative disorders characterized by inappropriate platetet derived growth factor receptor (PDGF-R) activity.[5b] Retinamide VNHM-1-73 exhibits strong in vivo antibreast cancer activity,[5c] and crotamiton is a scabicidal and antipruritic drug.[5d] Cyclopropyl ring is ranked the 10th in a top 100 list of the most frequently used rings in the synthesis of small molecule drugs, which can lock and orient a molecule into its bioactive conformation.[6] Thus, cyclopropylated *α,β*-unsaturated amides have been applied as important pharmaceutical agents. The analog of leflunomide metabolite is active in the clinical trials for rheumatoid arthritis, a chronic inflammatory disease.[7a] The grenadamide precursor can be efficiently hydrogenated to give grenadamide which has exhibited modest cannabinoid receptor-binding activity.[7b] The metabolite U-106305 of jawsamycin is an inhibitor of the cholesteryl ester transfer protein (CETP).[7c] Direct synthesis of *α,β*-unsaturated amides has been strongly desired due to the limitations of the conventional preparation methods[3] (Scheme 2a). Transition-metal-catalyzed procedures have recently been paid considerable attention for this purpose. Palladium[8] and iron[9]-catalyzed aminocarbonylation of alkynes with amines and CO gave highly chem- and regioselective *α,β*-unsaturated amides (Scheme 2b). Bimetallic Pd/Cu-catalyzed aerobic oxidative *N*-dealkylative carbonylation of tertiary amines and alkenes produced (*E*)-*α,β*-unsaturated amides using a CO-O_2 mixed gas[10] (Scheme 2c). Nickel-catalyzed intermolecular hydrocarbamoylation of alkynes with formamides afforded *α,β*-unsaturated amides[11] (Scheme 2d). However, these methods usually suffer from multi-step manipulations, use of transition-metal catalysts and additives, high pressure CO, and/or strong reducing reagents. In the context of drug development it is always desired to avoid the detrimental effect of transition-metal residues originated from both the transition-metal-catalyzed procedures and use of transition-metal additives, and the strategy to develop a green process usually requires mild reaction conditions and high atom-economy with less wastes.[2] Very recently, Loh and Jiang, et al. reported hypervalent iodine(III)-promoted acyloxylation/amidation of stable enamines to generate secondary amine-based amides.[12]

Scheme 2. Representative Strategies for the Synthesis of *α,β*-Unsaturated Amides



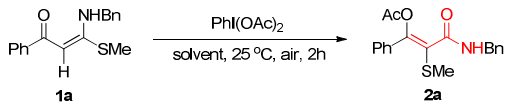
During the continuous investigation of sulfur-functionalized internal alkenes,[13] we envisioned that alkylthio-functionalized enaminones, that is, *α*-oxo ketene N,S-acetals,[14] which exist in various tautomers upon the reaction conditions, might undergo oxidative vicinal alkylthio group migration-assisted transformation to form *α,β*-unsaturated amides (Scheme 2e). The challenge is that enaminones can undergo olefinic C=C bond cleavage to afford *α*-keto amides in the presence of a transition-metal catalyst under oxidative conditions,[15] and an applicable approach for potential drug development often requires mild and metal-free conditions. Herein, we disclose a concise and efficient protocol for amide bond (–CONH–) formation from alkylthio-functionalized enaminones and hypervalent iodine(III) reagents under mild conditions.

RESULTS AND DISCUSSION

The reaction of enaminone **1a**, that is, (*E*)-3-(benzylamino)-3-(methylthio)-1-phenylprop-2-en-1-one, with phenyliodine(III) diacetate $PhI(OAc)_2$ (PIDA) was conducted to optimize the reaction conditions (Table 1). Enaminone **1a** reacted with PIDA in a 1:1.5 molar ratio in DMF and ethanol at ambient temperature gave the target product *α*,*β*-unsaturated amide **2a** in 17-22% yields (Table 1, entries 1 and 2). It is noteworthy that with 10 mol % $Pd(OAc)_2$ as the catalyst and excess of PIDA as the oxidant, *α*-acetyl ketene di(ethylthio)acetal reacted with acetic acid at 50 ^oC to form the olefinic C–H acetoxylation product in 23% yield.[16] These results have suggested that the functional groups at the termini of the internal olefinic C=C bond of enaminone **1a** are crucial to determine the substrate reactivity and direct the reaction towards formation of the *α*,*β*-unsaturated amide product. The solvent effect was remarkable in the cases of using dichloromethane, diethyl ether, 1,4-dioxane, and 1,2-dichloroethane (DCE) as the reaction media, leading to **2a** in 55-75% yields (Table 1, entries 3-6). Varying the amounts of PIDA or elevating the temperature to 40-60 ^oC diminished the reaction efficiency (Table 1, entries 7-10). It should be noted that phenyl iodide and acetic acid were detected as the by-products by GC analysis of the resultant reaction mixture.

The scope of enaminones **1** was then explored (Table 2) under the optimized reaction conditions as shown in entry 6 of Table 1. In the cases of using unsubstituted *α*-benzoyl enaminones **1a**-**j**, alkyl groups such as benzyl, methyl, ethyl, *n*-butyl, cyclohexyl, 1-phenylethyl, allyl, diphenylmethyl, 2-tetrahydrofuranylmethyl, and 2-furanylmethyl could be tolerated in the amino moiety (NHR^3), and the reactions afforded the target products **2a**-**j** in 60-90% yields. substituted benzoyl enaminones **1k**-**n** also efficiently reacted to produce products **2k**-**n** (69-86%). 2-Naphthoyl enaminone **1o** did not exhibit an obvious steric effect, forming product **2o** in 80% yield with isolation of *α*-methylthio-*β*-ketoamide **2o′** (5%) as the minor product. However, electron-withdrawing substituent CF_3 diminished the substrate reactivity to generate the target product **2p** in a relatively low yield (55%), and the minor product

Table 1. Screening of Conditions[a]



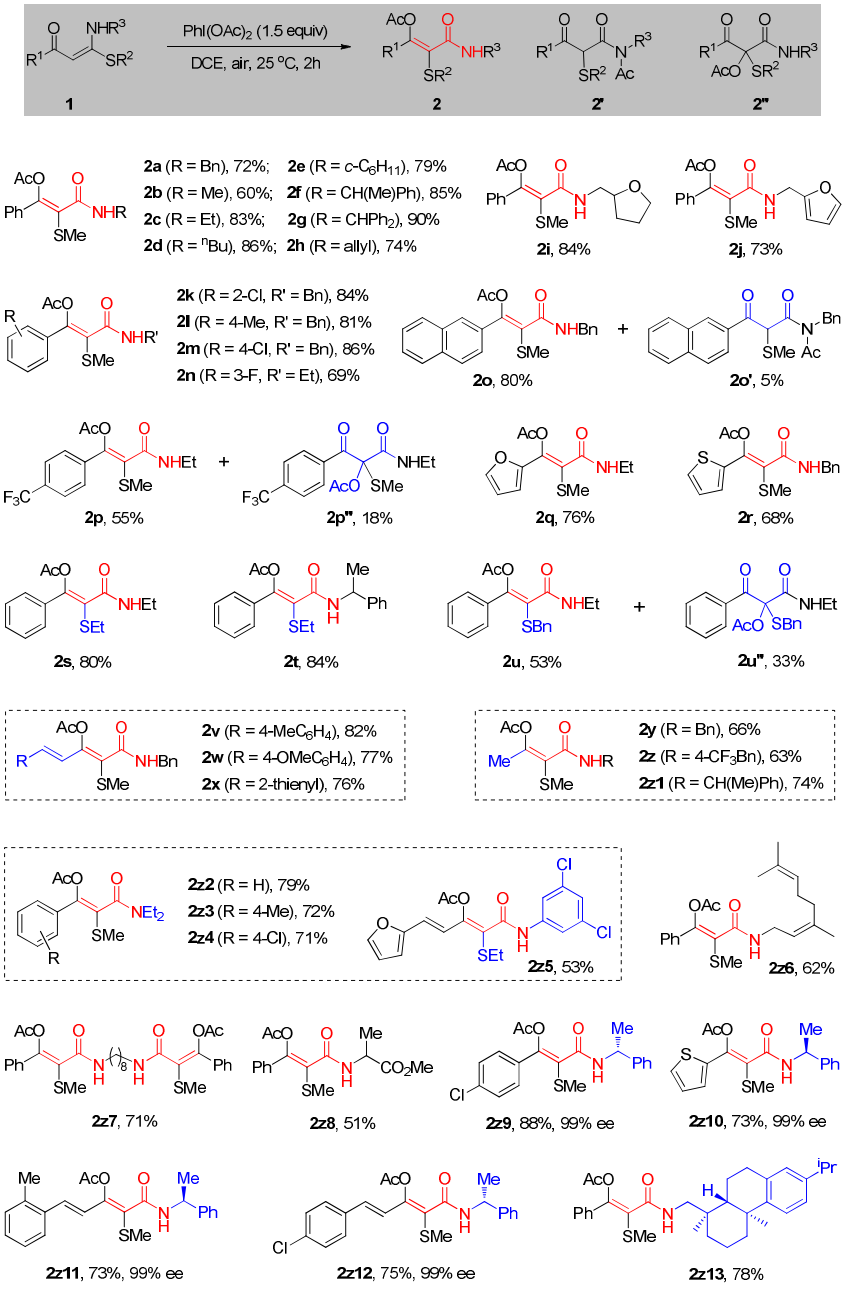
1a 2a

entry	$PhI(OAc)_2$ (equiv)	solvent	temp (°C)	yield[b] (%)
1	1.5	DMF	25	17
2	1.5	EtOH	25	22
3	1.5	CH_2Cl_2	25	55
4	1.5	Et_2O	25	63
5	1.5	1,4-dioxane	25	73
6	**1.5**	**DCE**	**25**	**75 (72)**[c]
7	2.0	DCE	25	71
8	1.0	DCE	25	45
9	1.5	DCE	40	69
10	1.5	DCE	60	44

[a] Conditions: **1a** (0.5 mmol), solvent (5 mL), in air, 2 h. [b]Determined by ^1H NMR analysis using 1,3,5-trimethoxyl-benzene as the internal standard. [c] Isolated yield given in parentheses. DCE = 1,2-dichloroethane.

α-acetoxy-*α*-methylthio-*β*-ketoamide **2p″** was obtained in 18% yield. The formation of compound **2p″** was similar to the production of the *α*-keto amides from copper-catalyzed oxidative C=C activation of enaminones in the presence of a hypervalent iodine(III) reagent.[15] The furoyl and thienoyl enaminones **1q** and **1r** exhibited a lower reactivity than their benzoyl analogs, and their reactions with PIDA afforded **2q** (76%) and **2r** (68%), respectively. Both ethylthio-functionalized enaminones **1s** and **1t** reacted slightly less efficiently than the corresponding methylthio analogs, forming **2s** (80%) and **2t** (84%). Unexpectedly, the reaction of benzylthio enaminone (**1u**) gave the target product **2u** (53%) with formation of *α*-acetoxy-*α*-benzylthio-*β*-ketoamide (**2u″**) in 33% yield. Alkenoyl-based enaminones **1v-x** also reacted well with PIDA to form β-vinylated acrylamides **2v-x** (76-82%). Acetyl enaminones **1y-z1** exhibited a reactivity lower than both the aroyl and alkenoyl enaminones, and their reactions with PIDA afforded amides **2y-z1** (63-74%). These

Table 2. Scope of Enaminones 1[a]



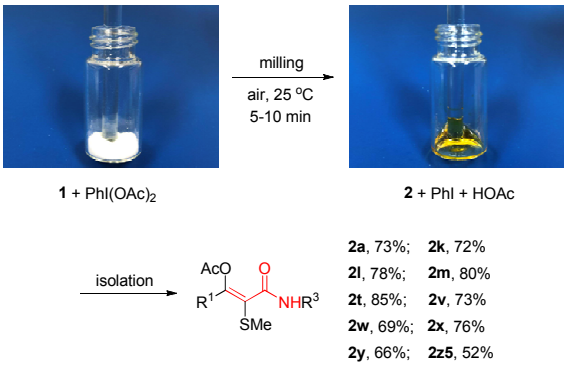
[a] Conditions: **1** (0.5 mmol), $PhI(OAc)_2$ (0.75 mmol), DCE (5 mL), in air, 25 °C, 2 h.

results have demonstrated a promising protocol to introduce an aryl, (hetero)aryl, alkenyl, and alkyl group onto a ketene moiety with formation of an amide bond under mild conditions.

Secondary amine-derived enaminones **1z2-z4** reacted with PIDA less efficiently than the primary amine-derived analogs to form **2z2-z4** (71-79%). However, in most of the cases using arylamine-derived enaminones the reactions formed complicated products, and only in the case of 3,5-dichloroaniline-based enaminone **1z5** the reaction yielded the target product *β*-vinyl-*α*,*β*-unsaturated amide **2z5** in a moderate yield (53%). It was noted that the enaminone of a dienylamine, that is, geranyl-amine, reacted with PIDA to afford the target amide **2z6** (62%) with the dienyl moiety remaining unchanged. 1,8-Octyl-diamine-derived enaminone **1z7** reacted with 3 equiv of PIDA to form the alkyl chain-bridged diamide **2z7** (71%). Interestingly, the reaction of enaminone **1z8** from *α*-amino acid ester, that is, alanine methyl ester, formed the peptide-type product **2z8** (51%). Chiral enaminones from the corresponding *α*-oxo ketene dithioacetals and chiral amines also efficiently reacted with PIDA, forming chiral *α*,*β*-unsaturated amides **2z9-z12** (73-88%) with retention of the chirality (99% ee). To our delight, the enaminone of the resolving agent dehydroabietylamine reacted with PIDA to form a complex *α*,*β*-unsaturated amide **2z13** (78%). It is noteworthy that on a gram-scale (5 mmol-scale) enaminones **1s** and **1z9** reacted with PIDA to form the corresponding amide products **2s** and **2z9** in 72% (1.06 g) and 87% (1.70 g) yields, respectively, and the molecular structures of compounds **2h**, **2o′**, and **2p″** were further confirmed by the X-ray single crystal structural analysis (see the Supporting Information for details).

The amide bond formation reactions of **1** with $PhI(OAc)_2$ could also be efficiently performed under solventless milling conditions. Simple mechanical milling the mixture of enaminone **1** and $PhI(OAc)_2$ with a glass rod at ambient temperature in air for 5-10 minutes initiated the reaction, affording the target amide product **2** in yields comparative to those obtained in the presence of a solvent (Scheme 3). Less amount of PIDA (1.2 equiv) was employed in these cases. Such a protocol was realized under the mild conditions, avoided use of a reaction solvent, and is thus characteristic of green chemistry,[17] which has demonstrated a potential for its application in synthetic chemistry.

Scheme 3. Amide Bond Formation Reactions Performed under the Solventless Milling Conditions

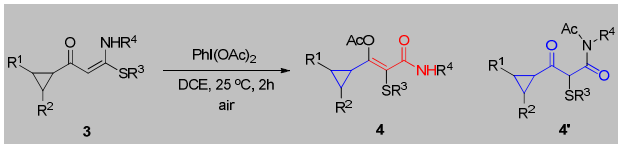


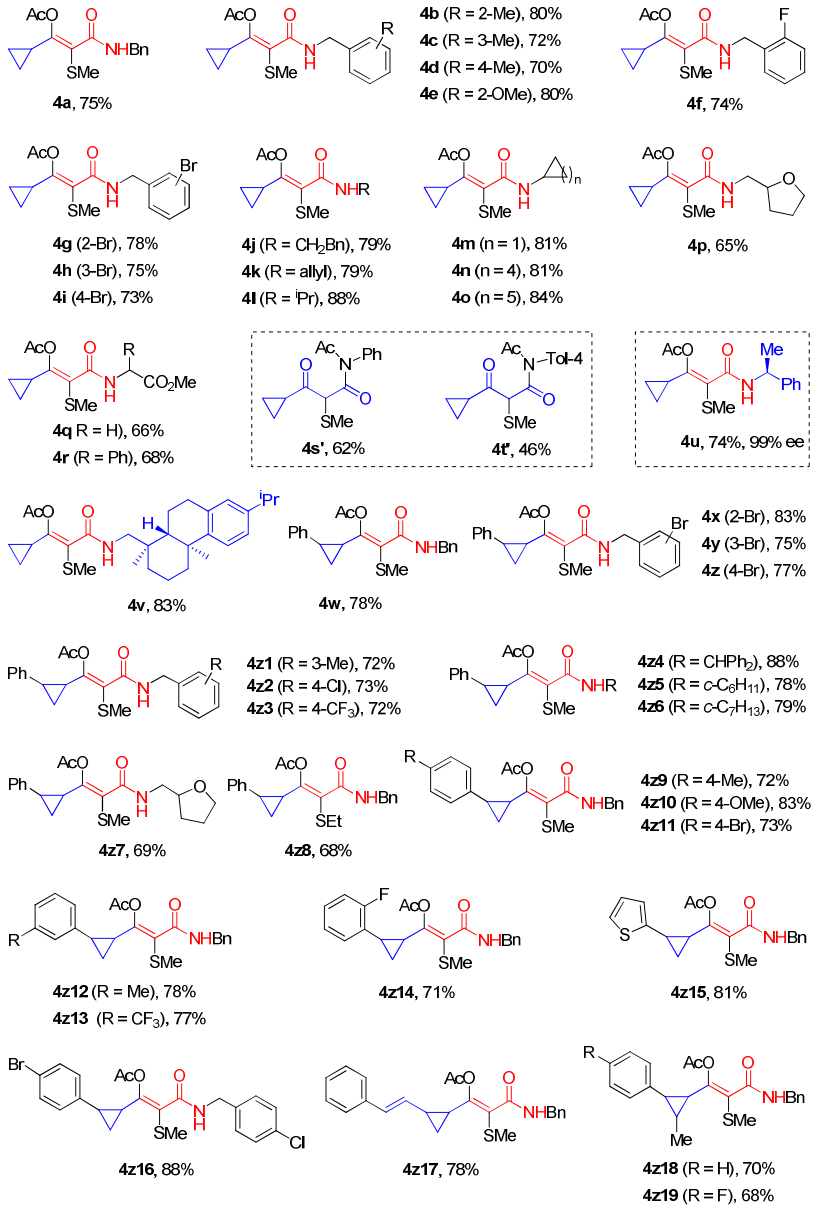
Conditions: **1** (0.5 mmol), $PhI(OAc)_2$ (0.6 mmol), 25 °C, in air. The reaction mixture was mechanically milled by a glass rod for 5-10 minutes, and then stayed without milling for 1-2 h to complete the reaction.

Cyclopropanation has been a challenging reaction in synthetic chemistry. Direct approaches to establish a cyclopropyl motif involves Simmons-Smith cyclopropanation using olefins and diiodomethane in the presence of activated zinc, and transition-metal catalyzed cyclopropanation of alkenes with diazo compounds and surrogates, which have been well defined and most widely used.[18] Recently, transition-metal catalyzed cross-coupling protocols by means of prefunctionalized cyclopropanes,[19] and activated cyclopropane derivatives through C–H activation strategy[20] have been documented for indirect introduction of a cyclopropyl ring into a complex molecular structure. Diverse synthesis of functionalized cyclopropanes under mild conditions is becoming more and more important for the convenient construction of potentially bioactive cyclopropylated acrylamides (Scheme 1).

Next, under the same optimal conditions enaminones of type **3**, that is, *α*-cyclopropylcarbonyl ketene N,S-acetals, were treated with PIDA to form the target *β*-cyclopropyl-*α*,*β*-unsaturated amides (*β*-cyclopropylated acrylamides) **4** (Table 3). Thus, unsubstitutited *β*-cyclopropylated acrylamide **4a** was obtained in 75% yield. The substituent on the aryl group in the benzylamino moiety (NHBn) exhibited an obvious impact on the yields of **4b-i** (70-80%), and electron-donating 2-methyl and

Table 3. Scope of Cyclopropylated Enaminones 3[a]





[a] Conditions: **1** (0.5 mmol), $PhI(OAc)_2$ (0.75 mmol), DCE (5 mL), in air, 25 °C, 2 h.

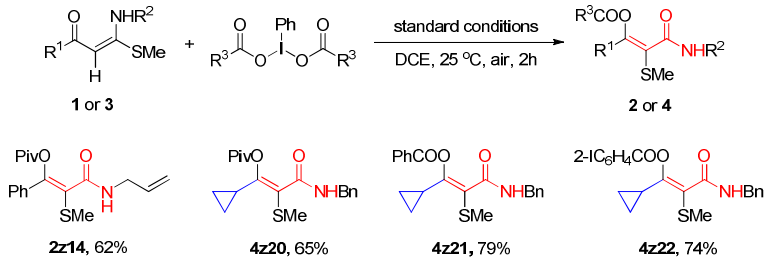
2-methoxy groups favored formation of both products **4b** and **4e** (80%). Other aliphatic acyclic or cyclic primary amine-derived cyclopropylated enaminones (**3j-o**)

also efficiently reacted with PIDA to give the target products **4j-o** in good to excellent yields (79-88%) with tolerance of 2-phenylethyl, allyl, *iso*propyl, cyclopropyl, cyclohexyl, and cycloheptyl in the NHR^3 moiety. However, enaminones **3p-r** derived from tetrahydrofuranylmethylamine and methyl α-aminoacetates reacted less efficiently with PIDA to form **4p-r** in 65-68% yields. Unexpectedly, the reactions of aniline-derived enaminones **3s** and **3t** with PIDA only formed α-methylthio-β-ketoamides of type **2′**, that is, **4s′** (62%) and **4t′** (46%), respectively. These results may be attributed to the extra stabilization of the aryl group in the NHAr moiety to the reaction intermediate of type **2′** leading to the β-cyclopropylated acrylamide product, which thus prevented the reaction from proceeding to generate the target α,β-unsaturated amide product. In a similar fashion, chiral enaminone **3u** efficiently reacted with PIDA to give chiral β-cyclopropyl-α,β-unsaturated amide **4u** (74%) with 99% ee. The enaminone of dehydroabietylamine (**3v**) reacted to produce the corresponding complex amide **4v** (83%). It should be noted that the molecular structures of compounds **4f** and **4s′** were further confirmed by the X-ray single crystal structural determinations (see the Supporting Information for details).

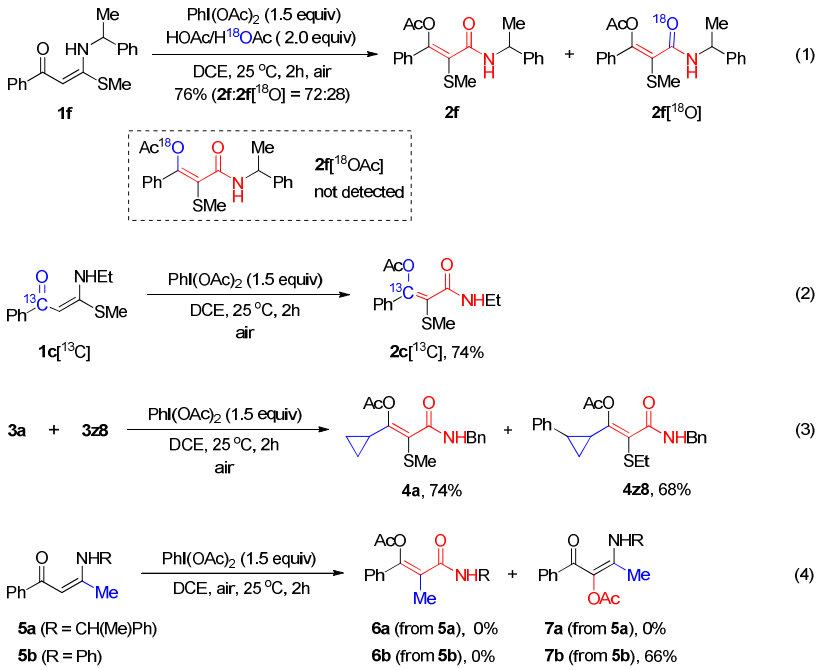
Substituted cyclopropylated enaminones **3w-z19** reacted well with PIDA to form the target β-cyclopropyl-α,β-unsaturated amides **4w-z19** in 68-88% yields. In most of the cases, the substrates exhibited a reactivity similar to that of the unsubstituted β-cyclopropylatedenaminones. Aryl, (hetero)aryl, alkenyl, and alkyl were tolerated as the substituent(s) on the cyclopropyl ring, which did not exhibit an obvious impact on the substrate reactivity. Increasing the steric hindrance on the cyclopropyl ring by introducing both an aryl and a methyl only slightly reduced the reaction efficiency to give **4z18** (70%) and **4z19** (68%). It is noteworthy that on a gram-scale (5-mmol scale) of enaminones **3a** and **3w** the target products **4a** and **4w** were prepared in 72% and 75% yields, respectively. Other PIDA-type hypervalent iodine(III) reagents were also applied as the oxidative amidation/acetoxylation reagents, leading to the target amide products **2z14** and **4z20-z22** in 62-79% yields (Scheme 4). Because a wide range of carboxylic acids are available for the preparation of iodine(III) reagents $ArI(OCOR)_2$,[21] diverse ester groups can be conveniently introduced onto the ketene

moiety of an α,β-unsaturated amide.

Scheme 4. Exploration of the Hypervalent Iodine Reagents (Piv = Pivaloyl)

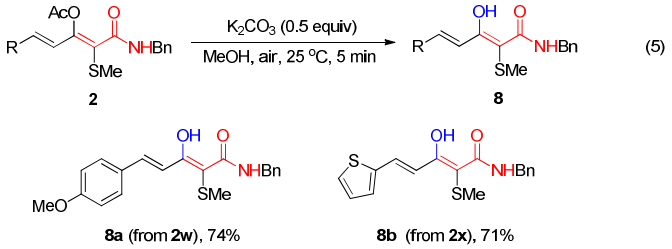


To gain insights into the reaction mechanism, control experiments were conducted. Reacting enaminone **1f** with PIDA in the presence of a mixture HOAc/H^{18}OAc generated in situ from $H_2{}^{18}O$ and Ac_2O afforded both the target amide **2f** and ^{18}O-labelled amide **2f**[^{18}O] in 76% yield with a molar ratio of **2f**:**2f**[^{18}O] = 72:28 (eq 1). The ^{18}O incorporation was identified in the amide carbonyl by the HRMS analysis of the mixed products, whereas ^{18}O-labelled amide **2f**[^{18}OAc] with ^{18}O incorporation in the acetoxyl group was not detected (see the Supporting Information). Exchange between $PhI(OAc)_2$ and H^{18}OAc formed ^{18}O-labelled $PhI(^{18}OAc)(OAc)$ and $PhI(^{18}OAc)_2$,[16] which then reacted with enaminone **1f** to give a mixture of **2f** and **2f**[^{18}O], suggesting that the amide oxygen in **2** and **4** was originated from PIDA, while the acetoxyl oxygen was from the original carbonyl group of **1** and **3**. The ^{13}C-labelled substrate **1c**[^{13}C] reacted with PIDA to form the corresponding ^{13}C-labelled amide product **2c**[^{13}C], which was unambiguously identified by the $^{13}C\{^1H\}$ NMR analysis, revealing that carbonyl migration to form the amide bond did not occur during the reaction (eq 2). In the presence of a radical scavengers such as TEMPO (2,2,6,6-tetramethyl-1-piperidyloxy) or BHT (2,6-di-*tert*-butyl-4-methyl-phenol), the reaction of **1a** with PIDA gave **2a** in 63% or 69% yield (versus 72% yield in the absence of a radical scavenger), implicating that a radical pathway was not involved in the reaction. A cross-over experiment was performed by treatment of a mixture of **3a** and **3z8** in 1:1 molar ratio with PIDA under the standard conditions, affording a mixture of amides **4a** (74%) and **4z8** (68%), which suggests that the alkyl-

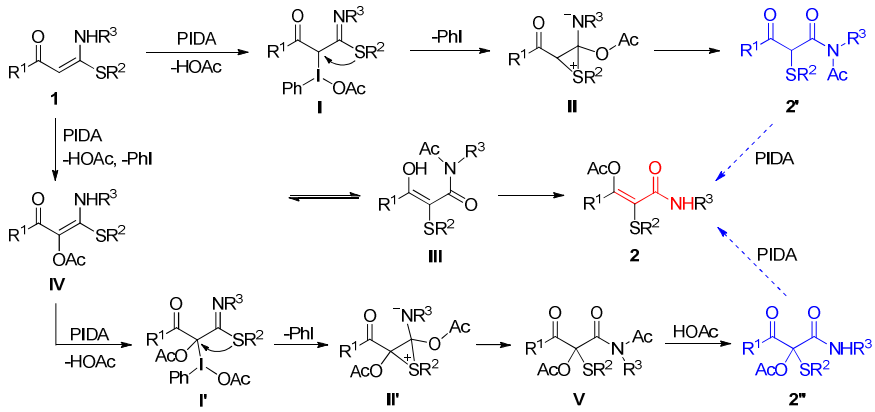


thio group migration occurs via an intramolecular pathway (eq 3). Next, the role of the alkylthio group was identified. Treatment of enaminones **5a** and **5b** bearing no alkylthio group with PIDA gave none of the target amide products **6a** and **6b**. However, in the case of using aniline-derived enaminone **5b** olefinic C–H acetoxylation underwent to generate the acetoxylated enaminone **7b** (66%) without occurrence of the methyl group transfer (eq 4). These results have demonstrated that an alkylthio group at the *N*-attached terminus of the ketene moiety of enaminones **1** and **3** is crucial to assist the oxidative amidation.[12,16] In particular, treatment of **2o′** and **2u″** under the standard conditions formed the target products **2o** and **2u**, respectively, revealing that both **2o′** and **2u″** were the reaction intermediates. Deacetoxylation of *β*-vinyl-*α*,*β*-unsaturated amides **2w** and **2x** was carried out with K_2CO_3 in methanol at ambient temperature, forming *β*-hydroxy-2,4-dienamides **8a** (74%) and **8b** (71%), respectively, demonstrating a potential application of the resultant *α*,*β*-unsaturated amide products (eq 5).

A plausible mechanism is proposed in Scheme 5. Initially, enaminone **1** interacts with PIDA to form iodo(III) intermediate **I** with release of acetic acid by deprotonation of the amino group. A redox process is followed to eliminate PhI and generate



Scheme 5. Proposed Mechanism



three-membered alkylthionium species **II** through intramolecular partial alkylthio group migration and nucleophilic attack of OAc anion at the imino carbon. Ring-opening of alkylthionium ion **II** with 1,3-acetyl migration accomplishes the vicinal alkylthio group migration, affording intermediate species **2′** which has been isolated and structurally identified by the X-ray single crystal structural determinations of **2o′** and **4s′**. Enolization of species **2′** followed by *N*-deacetylation/*O*-acetylation affords the target *α*,*β*-unsaturated amide product **2**. Alternatively, enaminone **1** reacts with PIDA to form the olefinic C–H acetoxylation intermediate **IV**,[16] which further interacts with PIDA to undergo deprotonative addition to give species **I′**. A process similar to the formation of alkylthionium species **II** occurs to generate species **II′**. Ring-opening of alkylthionium ion **II′** accompanied by 1,3-acetyl migration leads to species **V**, which then reacts with acetic acid generated *in situ* to afford intermediate species **2″**. Compounds **2″** were isolated and structurally confirmed by the X-ray single crystal structural analysis of **2p″** and **2u″**.

Conclusions

We have developed an amide bond formation protocol from readily available alkylthio-functionalized enaminones (α-oxo ketene N,S-acetals) with hypervalent iodine(III) reagents under mild conditions. Both primary and secondary amine-based enaminones can be employed as the substrates. Solventless mechanical milling can also be applied for the same purpose. Intramolecular vicinal alkylthio group migration is crucial for the amide bond formation, and the process tolerates a wide range of functional groups. The present work has provided a concise and convenient method to access multiply functionalized α,β-unsaturated amides including β-cyclopropylated acrylamides.

EXPERIMENTAL SECTION

General Considerations. The solvents were dried and distilled prior to use by the literature methods. ^{1}H and $^{13}C\{^{1}H\}$ NMR spectra were recorded on a 400 MHz NMR spectrometer and all chemical shift values refer to δ_{TMS} = 0.00 ppm or $CDCl_3$ ($\delta(^{1}H)$, 7.26 ppm; $\delta(^{13}C)$, 77.16 ppm). The HRMS (EI) analysis was obtained on a Q-TOF mass spectrometer. Enantiomeric excess was determined by chiral HPLC analysis. Optical rotations were measured by an polarimeter. All the melting points were uncorrected. Analytical TLC plates, Sigma-Aldrich silica gel 60_{F200} were viewed by UV light at 254 nm. Column chromatographic purifications were performed on silica gel. All the chemical reagents were purchased from commercial sources and used as received unless otherwise indicated. Known compounds **1a-c**,[22] **1d**, **1e**, and **1h**,[23] **1j**, **1k**, **1o**, **1r**, and **1z3**,[24] **1l** and **1m**,[25] **1w**, **1x**, and **1z5**,[26] **3s** and **3t**,[27] **5a**,[28] and **5b**[29] were prepared as reported. Compound **7b**[30] is known and its spectroscopic feature is in good agreement with that reported in the literature.

A typical procedure for the preparation of enaminones (α–oxo ketene *N,S*–acetals) 1a-u and 1y-z1 – *Synthesis of 1a:* A mixture of α–oxo ketene *S,S*–acetal **sm1a** (448 mg, 2 mmol) and benzylamine (430 mg, 4 mmol) in EtOH (5 mL) was stirred at 80 ^{o}C overnight. After compound **sm1a** was completely consumed by TLC monitoring on silica gel, the resultant mixture was cooled to ambient

temperature and evaporated all the volatiles under reduced pressure. Purification by silica gel column chromatography (eluent: petroleum ether (60–90 °C)/AcOEt = 30:1, v/v) afforded enaminone **1a** (489 mg, 86%) as a yellow solid.

A typical procedure for the preparation of enaminones 1z2-z4 – ***Synthesis of 1z2:*** In a fashion similar to the synthesis of enaminone **1a**, compound **sm1a** (448 mg, 2 mmol) reacted with diethylamine (295 mg, 4 mmol) in CH_3CN (5 mL) at 80 ^oC to afford enaminone **1z2** (280 mg, 53%) as a yellow liquid.

A typical procedure for the preparation of enaminones (α–alkenoyl ketene *N,S*-acetals) 1v-x – ***Synthesis of 1v:*** A mixture of $BF_3{\cdot}OEt_2$ (0.142 g, 1 mmol), compound **sm1v** (2.640 g, 10 mmol) and benzylamine (1.183 g, 11 mmol) in toluene (30 mL) was heated to reflux with stirring. When TLC monitoring on silica gel indicated complete consumption of **sm1v**, the mixture was cooled to ambient temperature and evaporated all the volatiles under reduced pressure. Purification by silica gel column chromatography (eluent: petroleum ether (60–90 °C)/AcOEt = 30:1, v/v) afforded enaminone **1v** (2.200 g, 68%) as a yellow solid.

A typical procedure for the preparation of enaminones (α–cyclopropyl-carbonyl ketene *N,S*–acetals) 3a-z19 – ***Synthesis of 3w:*** A mixture of compound **sm3w** (500 mg, 2 mmol), trimethylsulfoxonium iodide (440 mg, 2 mmol), NaOH (800 mg, 20 mmol), and tetrabutylammonium bromide (322, 1 mmol) in 20 mL CH_2Cl_2/H_2O (v/v = 1:1) was stirred at 50 ^oC overnight. After TLC monitoring on silica gel indicated complete consumption of compound **sm3w**, the mixture was cooled to ambient temperature. The organic phase was separated and dried over anhydrous Na_2SO_4, and evaporated all the volatiles under reduced pressure. The resultant residue was purified by silica gel column chromatography (eluent: petroleum ether (60–90 °C)/AcOEt = 10:1, v/v), affording α–oxo ketene dithioacetal **sm3w′** (423 mg, 80%) as a white solid. And the preparation of enaminone **3w** was accompolished from the reaction of **sm3w′** with benzylamine by following the procedure used for the synthesis of enaminone **1a**.

Preparation of ^{13}C–labelled α–oxo ketene *S,S*–acetal sm1a[^{13}C]: Iodomethane (4.260 g, 30 mmol) was added dropwise to a stirred mixture of aceto-^{13}C-phenone

(**sm2**) (1.170 g, 10 mmol), NaH (0.800 g, 60% in oil, 20 mmol), CS_2 (1.145 g, 15 mmol), and DMF (1 mL) in 19 mL toluene at 0 ^oC. The reaction was continued for 24 h. The resulting mixture was poured into 20 g of ice water, extracted with CH_2Cl_2 (3×15 mL). The combined organic phase was dried over anhydrous Na_2SO_4, and filtered. All the volatiles were removed under reduced pressure, and the residue was purified by silica gel column chromatography (eluent: petroleum ether (60–90 °C)/AcOEt = 30:1, v/v), affording **sm1a**[^{13}C] (1.600 g, 71%) as a yellow solid.

Preparation of ^{13}C–labelled enaminone 1c[^{13}C]: In a fashion similar to the preparation of enaminone **1a**, a mixture of α–oxo ketene *S,S*–acetal **sm1a**[^{13}C] (225 mg, 1 mmol) and ethylamine (370 mg, 5 mmol) in EtOH (5 mL) was stirred at 80 ^oC overnight. After compound **sm1a**[^{13}C] was completely consumed by TLC monitoring on silica gel, the mixture was cooled to ambient temperature and evaporated all the volatiles under reduced pressure. The resultant residue was purified by silica gel column chromatography (eluent: petroleum ether (60–90 °C)/AcOEt = 30:1, v/v), affording **1c**[^{13}C] (192 mg, 87%) as a colorless liquid.

A typical procedure for the synthesis of *α,β*–unsaturated amides 2 and 4 – *synthesis of (E)-3-(benzylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2a):* $PhI(OAc)_2$ (242 mg, 0.75 mmol) was added to a stirred solution of enaminone **1a** (142 mg, 0.5 mmol) in 1,2-dichloroethane (DCE) (5 mL), and the reaction was continued at ambient temperature for 2 h until compound **1a** was completely consumed by TLC monitoring on silica gel. The resultant mixture was purified by silica gel column chromatography (eluent: petroleum ether (60–90 ^oC)/AcOEt = 10:1, v/v) to afford amide **2a** (123 mg, 72%) as a white solid.

A typical procedure for the synthesis of *α,β*–unsaturated amides 2 under the solventless mechanical milling conditions – *synthesis of (2a):* A mixture of $PhI(OAc)_2$ (194 mg, 0.6 mmol) and enaminone **1a** (142 mg, 0.5 mmol) was mechanically milled in a 5-mL glass vial by a glass rod for 5 minutes, and the resultant yellow liquid mixture was allowed to stay in air at ambient temperature without milling for about 2 h until compound **1a** was completely consumed by TLC

monitoring on silica gel. The resulting mixture was purified by silica gel column chromatography (eluent: petroleum ether (60–90 ^{o}C)/AcOEt = 10:1, v/v) to afford amide **2a** (125 mg, 73%) as a white solid.

Gram-scale preparation – *synthesis of (E)-3-(ethylamino)-2-(ethylthio)-3-oxo-1-phenylprop-1-enyl acetate (2s):* $PhI(OAc)_2$ (2.42 g, 7.5 mmol) was added to a stirred solution of enaminone **1s** (1.18 g, 5 mmol) in 1,2-dichloroethane (10 mL) at ambient temperature, and the reaction was continued for 2 h until compound **1s** was completely consumed by TLC monitoring on silica gel. The resultant mixture was purified by silica gel column chromatography (eluent: petroleum ether (60–90 ^{o}C)/AcOEt = 10:1, v/v) to afford amide **2s** (1.06 g, 72%) as a white solid.

^{18}O–Labelling experiment: A mixture of Ac_2O (62 mg, 0.6 mmol) and $H_2{}^{18}O$ (20 mg, 0.5 mmol, 90% ^{18}O) was stirred at 60 ^{o}C for 30 minutes. After cooled to ambient temperature, 1,2-dichloroethane (2 mL), enaminone **1f** (89 mg, 0.3 mmol), and $PhI(OAc)_2$ (145 mg, 0.45 mmol) were successively added with stirring. The reaction was continued at ambient temperature for 2 h until compound **1f** was completely consumed by TLC monitoring on silica gel. The resultant mixture was purified by silica gel column chromatography (eluent: petroleum ether (60–90 ^{o}C)/AcOEt = 10:1, v/v) to afford a 72:28 molar ratio mixture of the target amide product **2f** and ^{18}O–labelled amide product **2f**[^{18}O] as a white solid (76%). Amide **2f**[^{18}O] was identified by the HRMS analysis, whereas amide **2f**[^{18}OAc] was not detected in the reaction mixture.

Radical trapping experiments: $PhI(OAc)_2$ (242 mg, 0.75 mmol) was added to a stirred mixture of enaminone **1a** (142 mg, 0.5 mmol), TEMPO (2,2,6,6-tetramethyl-1-piperidyloxy) or BHT (2,6-di-*tert*-butyl-4-methylphenol) (1.5 mmol) in 1,2-dichloro-ethane (5 mL) at ambient temperature, and the reaction was continued for 2 h until **1a** was completely consumed by TLC monitoring on silica gel. The resultant mixture was purified by silica gel column chromatography (eluent: petroleum ether (60–90 ^{o}C)/AcOEt = 10:1, v/v) to afford **2a** as a white solid (65% or 69%).

Cross-over experiment: $PhI(OAc)_2$ (484 mg, 1.50 mmol) was added to a stirred mixture of enaminones **3a** (124 mg, 0.5 mmol) and **3z8** (169 mg, 0.5 mmol) in

1,2-dichloroethane (5 mL) at ambient temperature. The reaction was continued for 2 h until compounds **3a** and **3z8** were completely consumed by TLC monitoring on silica gel. The resultant mixture was purified by silica gel column chromatography (eluent: petroleum ether (60–90 ^{o}C)/AcOEt = 10:1, v/v) to afford **4a** (113 mg, 74%) and **4z8** (134 mg, 68%), respectively.

Reactions of enaminones 5 with $PhI(OAc)_2$ – *synthesis of (E)-1-oxo-1-phenyl-3-(phenylamino)but-2-en-2-yl acetate (7b)*: $PhI(OAc)_2$ (242 mg, 0.75 mmol) was added to a stirred mixture of (*Z*)-1-phenyl-3-(phenylamino)but-2-en-1-one (**5b**) (119 mg, 0.5 mmol), in 1,2-dichloroethane (5 mL) at ambient temperature. The reaction was continued for 2 h until compound **5b** was completely consumed by TLC monitoring on silica gel. Purification of the resultant mixture by silica gel column chromatography (eluent: petroleum ether (60–90 ^{o}C)/AcOEt = 10:1, v/v) afforded **7b** (97 mg, 66%) as a white solid. The target amide product **6b** was not detected in the reaction mixture.

Deacetoxylation with K_2CO_3 – *synthesis of* (2*E*,4*E*)-*N-benzyl-3-hydroxy-5-(4-methoxyphenyl)-2-(thiomethyl)penta-2,4-dienamide (8a):* A mixture of amide **2l** (119 mg, 0.3 mmol) and K_2CO_3 (21 mg, 0.15 mmol) in MeOH (3 mL) was stirred at ambient temperature for five minute. Then 10 mL water was added and the mixture was extracted with CH_2Cl_2 (3×10 mL). The combined organic phase was dried over anhydrous Na_2SO_4, and filtered. All the volatiles were evaporated under reduced pressure. Purification by silica gel column chromatography (eluent: petroleum ether (60–90 ^{o}C)/AcOEt = 50:1, v/v) gave **8a** (79 mg, 74%) as a yellow solid.

(*E*)-3-(Ethylamino)-3-(thiomethyl)-1-phenylprop-2-en-1-one-^{13}C (1c[^{13}C]): 192 mg, yield 87%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.78 (br s, 1 H), 7.83, 7.37 (m each, 2:3 H), 5.61 (d, J = 2.0 Hz, 1 H), 3.38 (m, 2 H), 2.40 (s, 3 H), 1.29 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.0, 169.3, 140.7 (d, J = 54.5 Hz), 130.3, 128.1 (d, J = 3.8 Hz), 126.8 (d, J = 2.4 Hz), 85.9 (d, J = 63.9 Hz), 38.7, 14.8, 14.1. HRMS (EI) calcd for $C_{11}{}^{13}CH_{16}NOS$ $[M+H]^+$: 223.0986; Found: 223.0982.

(*E*)-3-(Thiomethyl)-1-phenyl-3-(1-phenylethylamino)prop-2-en-1-one (1f): 2.14 g, yield 72%, yellow solid, mp 80-82 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.35 (d, J = 6.8 Hz, 1 H), 7.87, 7.42, 7.35, 7.27 (m each, 2:3:4:1 H), 5.68 (s, 1 H), 4.90 (m, 1 H), 2.40 (s, 3 H), 1.64 (d, J = 6.8 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.6, 169.0, 143.5, 40.8, 130.7, 128.9, 128.4, 127.5, 127.1, 126.1, 86.9, 54.3, 24.6, 14.7. HRMS (EI) calcd for $C_{18}H_{20}NOS$ $[M+H]^+$: 298.1266; Found: 298.1266.

(*E*)-3-(Benzhydrylamino)-3-(thiomethyl)-1-phenylprop-2-en-1-one (1g): 1.04 g, yield 29%, white solid, mp 125-128 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.75 (d, J = 7.8 Hz, 1 H), 7.90 (dd, J = 7.9 and 1.7 Hz, 2 H), 7.45, 7.38, 7.31 (m each, 3:8:2 H), 6.05 (d, J = 8.1 Hz, 1 H), 5.78 (s, 1 H), 2.46 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.9, 168.8, 141.4, 140.7, 130.8, 129.0, 128.4, 127.8, 127.4, 127.2, 87.5, 62.4, 14.8. HRMS (EI) calcd for $C_{23}H_{22}NOS$ $[M+H]^+$: 360.1422; Found: 360.1420.

(*E*)-3-(Thiomethyl)-1-phenyl-3-((tetrahydrofuran-2-yl)methylamino)prop-2-en-1-one (1i): 1.99 g, yield 72%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.85 (t, 1 H), 7.75, 7.25 (m each, 2:3 H), 5.54 (s, 1 H), 4.96 (m, 1 H), 3.32 (m, 2 H), 1.79, 1.51 (m each, 1:2:3:1 H), 3.80, 3.63 (dd each, J = 14.7 and 7.0 Hz, 1:1 H), 2.27 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 184.6, 169.0, 140.2, 129.9, 127.7, 126.4, 86.1, 76.6, 67.9, 28.5, 25.4, 47.4, 13.8. HRMS (EI) calcd for $C_{15}H_{20}NO_2S$ $[M+H]^+$: 278.1215; Found: 278.1215.

(*E*)-3-(Ethylamino)-1-(3-fluorophenyl)-3-(thiomethyl)prop-2-en-1-one (1n): 1.70 g, yield 71%, colorless liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.68 (br s, 1 H), 7.50 (d, J = 7.8 Hz), 7.44, 7.22, 6.98 (1:1:1:1 H), 5.47 (s, 1 H), 3.29 (m, 2 H), 2.32 (s, 3 H), 1.20 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 183.0 (d, J = 2.1 Hz), 169.9, 162.7 (d, J = 245.9 Hz), 143.1 (d, J = 6.2 Hz), 129.6 (d, J = 7.8 Hz), 122.3 (d, J = 2.8 Hz), 117.0 (d, J = 21.5 Hz), 113.6 (d, J = 22.1 Hz), 85.8, 38.7, 14.6, 14.1. HRMS (EI) calcd for $C_{12}H_{15}NOSF$ $[M+H]^+$: 240.0858; Found: 240.0858.

(*E*)-3-(Ethylamino)-3-(thiomethyl)-1-(4-(trifluoromethyl)phenyl)prop-2-en-1-one (1p): 1.82 g, yield 63%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.83 (br s, 1 H), 7.90, 7.61 (d each, J = 8.1 Hz, 2:2 H), 5.58 (s, 1 H), 3.39 (m, 2 H), 2.42 (s, 3 H), 1.30 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 183.2, 170.4, 144.1,

131.8 (q, J = 32.4 Hz), 127.16, 125.18 (q, J = 3.8 Hz), 124.1 (q, J = 272.3 Hz), 86.2, 38.9, 14.7, 14.2. HRMS (EI) calcd for $C_{13}H_{15}NOSF_3$ $[M+H]^+$: 290.0826; Found: 290.0826.

(*E*)-3-(Ethylamino)-1-(furan-2-yl)-3-(thiomethyl)prop-2-en-1-one (1q): 1.90 g, yield 90%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.39 (br s, 1 H), 7.33 (m, 1 H), 6.88 (dd, J = 3.4 and 0.5 Hz, 1 H), 6.34 (dd, J = 3.4 and 1.7 Hz, 1 H), 5.52 (s, 1 H), 3.27 (m, 2 H), 2.33 (s, 3 H), 1.17 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 174.3, 169.5, 154.3, 143.4, 111.8, 111.6, 85.1, 38.6, 14.5, 14.0. HRMS (EI) calcd for $C_{10}H_{14}NO_2S$ $[M+H]^+$: 212.0745; Found: 212.0740.

(*E*)-3-(Ethylamino)-3-(thioethyl)-1-phenylprop-2-en-1-one (1s): 1.20 g, yield 51%, colorless liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.82 (br s, 1 H), 7.82, 7.37 (m each, 2:3 H), 5.67 (s, 1 H), 3.39 (m, 2 H), 2.95 (m, 2 H), 1.38 (t, J = 7.2 Hz, 3 H), 1.29 (t, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.0, 168.5, 140.8, 130.3, 128.2, 126.8, 86.7, 38.7, 25.6, 14.8, 13.6. HRMS (EI) calcd for $C_{13}H_{18}NOS$ $[M+H]^+$: 236.1109; Found: 236.1110.

(*E*)-3-(Thioethyl)-1-phenyl-3-(1-phenylethylamino)prop-2-en-1-one (1t): 2.39 g, yield 77%, yellow solid, mp 106-108 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.48 (d, J = 7.3 Hz, 1 H), 7.92, 7.45, 7.39, 7.30 (m each, 2:3:4:1 H), 5.78 (s, 1 H), 4.98 (m, J = 6.9 Hz, 1 H), 2.95 (m, 2 H), 1.67 (d, J = 6.8 Hz, 3 H), 1.38 (t, J = 7.4 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.3, 168.0, 143.4, 140.6, 130.5, 128.7, 128.2, 127.3, 126.9, 125.9, 87.4, 54.1, 26.0, 24.4, 13.5. HRMS (EI) calcd for $C_{19}H_{22}NOS$ $[M+H]^+$: 312.1422; Found: 312.1426.

(*E*)-3-(Benzylthio)-3-(ethylamino)-1-phenylprop-2-en-1-one (1u): 1.72 g, yield 58%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.63 (br s, 1 H), 7.64, 7.18 (m each, 2:8 H), 5.60 (s, 1 H), 4.01 (s, 2 H), 3.24 (m, 2 H), 1.12 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.2, 167.9, 140.6, 134.8, 130.4, 128.9, 128.8, 128.1, 127.9, 126.8, 87.6, 38.8, 36.2, 14.9. HRMS (EI) calcd for $C_{18}H_{20}NOS$ $[M+H]^+$: 298.1266; Found: 298.1267.

(1*E*,4*E*)-1-(Benzylamino)-1-(thiomethyl)-5-p-tolylpenta-1,4-dien-3-one (1v): 1.52 g, yield 47%, yellow solid, mp 81-84 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.28

(br s, 1 H), 7.51, 6.65 (d each, J = 15.7 Hz, 1:1 H), 7.40, 7.12 (d each, J = 8.0 Hz, 2:2 H), 7.30, 7.23 (m each, 4:1 H), 5.16 (s, 1 H), 4.52 (m, 2 H), 2.34 (s, 3 H), 2.31 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 183.0, 169.3, 139.1, 137.6, 127.5, 137.1, 133.1, 129.4, 128.7, 127.7, 127.2, 91.5, 47.8, 21.3, 14.2. HRMS (EI) calcd for $C_{20}H_{22}NOS$ $[M+H]^+$: 324.1422; Found: 324.1415.

(*E*)-4-(Benzylamino)-4-(thiomethyl)but-3-en-2-one (1y): 1.10 g, yield 50%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 11.68 (br s, 1 H), 7.36-7.25 (m, 5 H), 5.03 (d, J = 2.4 Hz, 1 H), 4.53 (t, 2 H), 2.34 (dd, J = 6.5 and 1.5 Hz, 3 H), 2.08 (d, J = 2.5 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 192.1, 167.9, 137.4, 128.6, 127.4, 127.1, 89.7, 47.5, 29.0, 14.2. HRMS (EI) calcd for $C_{12}H_{16}NOS$ $[M+H]^+$: 222.0953; Found: 222.0953.

(*E*)-4-(Thiomethyl)-4-(4-(trifluoromethyl)benzylamino)but-3-en-2-one (1z): 1.01 g, yield 35%, yellow solid, mp 66-67 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.69 (br s, 1 H), 7.53, 7.35 (d, J = 8.2 Hz, 2:2 H), 5.01 (s, 1 H), 4.52 (d, J = 6.3 Hz, 2 H), 2.28 (s, 3 H), 2.03 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 192.9, 167.9, 141.7, 129.6 (q, J = 32.4 Hz), 127.2, 125.5 (q, J = 3.8 Hz), 124.0 (q, J = 272.1 Hz), 90.2, 46.9, 29.0, 14.0. HRMS (EI) calcd for $C_{13}H_{15}NOSF_3$ $[M+H]^+$: 290.0826; Found: 290.0827.

(*E*)-4-(Thiomethyl)-4-(1-phenylethylamino)but-3-en-2-one (1z1): 1.53 g, yield 65%, yellow solid, mp 51-54 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.86 (br s, 1 H), 7.36, 7.30 (m each, 2:3 H), 5.00 (s, 1 H), 4.83 (p, J = 6.9 Hz, 1 H), 2.30 (s, 3 H), 2.11 (s, 3 H), 1.59 (d, J = 6.8 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 192.2, 167.4, 143.6, 128.8, 127.3, 125.9, 89.6, 53.9, 29.2, 24.6, 14.4. HRMS (EI) calcd for $C_{13}H_{18}NOS$ $[M+H]^+$: 236.1109; Found: 236.1112.

(*E*)-3-(Diethylamino)-3-(thiomethyl)-1-phenylprop-2-en-1-one (1z2): 1.39 g, yield 56%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.83, 7.36 (m each, 2:3 H), 5.83 (s, 1 H), 3.55 (m, 4 H), 2.45 (s, 3 H), 1.20 (m, 6 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 184.3, 169.3, 142.3, 130.2, 128.0, 127.3, 92.9, 47.0, 18.2, 13.3. HRMS (EI) calcd for $C_{14}H_{20}NOS$ $[M+H]^+$: 250.1266; Found: 250.1273.

(*E*)-1-(4-Chlorophenyl)-3-(diethylamino)-3-(thiomethyl)prop-2-en-1-one (1z4): 1.22 g, yield 43%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 and 7.33 (d each, J = 8.5 Hz, 2:2 H), 5.76 (s, 1 H), 3.57 (m, 4 H), 2.46 (s, 3 H), 1.21 (m, 6 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 182.7, 169.9, 140.7, 136.3, 128.8, 128.3, 92.4, 47.2, 18.3, 13.4. HRMS (EI) calcd for $C_{14}H_{19}NOSCl$ $[M+H]^+$: 284.0876; Found: 284.0876.

(*E*)-3-((*Z*)-3,7-Dimethylocta-2,6-dienylamino)-3-(thiomethyl)-1-phenylprop-2-en-1-one (1z6): 409 mg, yield 62%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.73 (t, 1 H), 7.78 (dd, J = 7.2 and 2.4 Hz, 2 H), 7.27 (m, 3 H), 5.55 (s, 1 H), 5.24 and 5.02 (t, 1:1 H), 3.87 (t, 2 H), 2.28 (s, 3 H), 2.03 (dd, J = 14.8 and 6.5 Hz, 2 H), 1.95 (m, 2 H), 1.61, 1.60, and 1.53 (s each, 3:3:3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 184.4, 168.7, 140.4, 139.9, 131.2, 130.0, 127.8, 126.5, 123.5, 118.8, 85.7, 41.5, 39.1, 26.0, 25.3, 17.3, 16.0, 13.9. HRMS (EI) calcd for $C_{20}H_{28}NOS$ $[M+H]^+$: 330.1892; Found: 330.1887.

(*E*)-3-(Thiomethyl)-3-(8-((E)-1-(thiomethyl)-3-oxo-3-phenylprop-1-enylamino)octylamino)-1-phenylprop-2-en-1-one (1z7): 883 mg, yield 89%, white solid, mp 125-127 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.87 (s, 2 H), 7.84, 7.39 (m each, 4:6 H), 5.63 (s, 2 H), 3.37 (dd, J = 12.8 and 6.8 Hz, 4 H), 2.46 (s, 6 H), 1.69, 1.42, 1.37 (m, 4:4:4 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.2, 169.6, 140.9, 130.5, 128.3, 127.0, 86.2, 44.2, 29.6, 29.1, 26.9, 14.4. HRMS (EI) calcd for $C_{28}H_{37}N_2O_2S_2$ $[M+H]^+$: 497.2296; Found: 497.2299.

(*S,E*)-Methyl 2-(1-(thiomethyl)-3-oxo-3-phenylprop-1-enylamino)propanoate (1z8): 1.14 g, yield 41%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.97 (d, J = 8.0 Hz, 1 H), 7.78, 7.29 (m each, 2:3 H), 5.62 (s, 1 H), 4.34 (m, 1 H), 3.63 (s, 3 H), 2.31 (s, 3 H), 1.45 (d, J = 7.0 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.3, 171.7, 167.7, 139.9, 130.3, 127.8, 126.6, 87.1, 52.1, 51.9, 18.7, 14.0. HRMS (EI) calcd for $C_{14}H_{18}NO_3S$ $[M+H]^+$: 280.1007; Found: 280.1009.

(*R,E*)-1-(4-Chlorophenyl)-3-(thiomethyl)-3-(1-phenylethylamino)prop-2-en-1-one (1z9): 2.55 g, yield 77%, yellow solid, mp 75-76 ^{o}C, 99% ee, $[\alpha]^{20}_D$ = +573.56 (*c* 1.00, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.37 (d, J = 6.6 Hz, 1 H), 7.82 (d, J =

8.5 Hz, 2 H), 7.36, 7.27 (m each, 6:1 H), 5.62 (s, 1 H), 4.90 (p, J = 6.9 Hz, 1 H), 2.38 (s, 3 H), 1.64 (d, J = 6.8 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 183.9, 169.3, 143.2, 139.0, 136.6, 128.8, 128.4, 128.3, 127.5, 125.9, 86.4, 54.2, 24.5, 14.6. HRMS (EI) calcd for $C_{18}H_{19}NOSCl$ $[M+H]^+$: 332.0876; Found: 332.0882. HPLC (OG-H column, ^{i}PrOH/*n*-hexane 10/90, 0.7 mL/min, 254 nm): t_1 = 9.92 min (major), t_2 = 14.94 min.

(*S*,*E*)-3-(Thiomethyl)-3-(1-phenylethylamino)-1-(thiophen-2-yl)prop-2-en-1-one (1z10): 1.79 g, yield 59%, yellow solid, mp 108-111 ^{o}C, 98% ee, $[\alpha]^{20}_D$ = -635.06 (*c* 1.00, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 11.86 (d, J = 7.1 Hz, 1 H), 7.44 (d, J = 3.6 Hz, 1 H), 7.32 (d, J = 4.9 Hz, 1 H), 7.23, 7.15 (m each, 4:1 H), 6.95 (m, 1 H), 5.46 (s, 1 H), 4.76 (p, J = 6.9 Hz, 1 H), 2.25 (s, 3 H), 1.50 (d, J = 6.8 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 178.4, 168.6, 147.1, 143.3, 129.7, 128.8, 127.7, 127.3, 127.2, 125.9, 86.3, 54.1, 24.5, 14.5. HRMS (EI) calcd for $C_{16}H_{18}NOS_2$ $[M+H]^+$: 304.0830; Found: 304.0826. HPLC (OG-H column, *i*PrOH/hexane 15/85, 0.8 mL/min, 254 nm): t_1 = 9.62 min (major), t_2 = 15.69 min.

***(1E,4E)*-1-(Thiomethyl)-1-((S)-1-phenylethylamino)-5-o-tolylpenta-1,4-dien-3-one (1z11):** 1.41 g, yield 42%, yellow liquid, 99% ee, $[\alpha]^{20}_D$ = +671.54 (*c* 1.00, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 12.56 (d, J = 7.7 Hz, 1 H), 7.93, 6.68 (d each, J = 15.5 Hz, 1:1 H), 7.62 (d, J = 7.4 Hz, 1 H), 7.35 (d, J = 4.4 Hz, 4 H), 7.26, 7.20 (m, 1:3 H), 5.17 (s, 1 H), 4.87 (p, J = 6.8 Hz, 1 H), 2.49 (s, 3 H), 2.28 (s, 3 H), 1.63 (d, J = 6.8 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 182.4, 168.9, 143.0, 137.2, 134.6, 135.0, 127.2 , 130.5, 129.5, 128.7, 128.6, 125.9, 125.8, 125.7, 91.6, 54.0, 24.3, 19.8, 14.1. HRMS (EI) calcd for $C_{21}H_{24}NOS$ $[M+H]^+$: 338.1579; Found: 338.1580. HPLC (OD-H column, *i*PrOH/hexane 30/70, 0.7 mL/min, 230 nm): t_1 = 5.8 min (major), t_2 = 15.3 min.

(*1E,4E*)-5-(4-Chlorophenyl)-1-(thiomethyl)-1-((R)-1-phenylethylamino)penta-1,4-dien-3-one (1z12): 0.75 g, yield 21%, yellow liquid, 99% ee, $[\alpha]^{20}_D$ = -237.71 (*c* 1.00, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 12.53 (d, J = 7.6 Hz, 1 H), 7.52, 6.67 (d each, J = 15.7 Hz, 1:1 H), 7.45 (d, J = 8.5 Hz, 2 H), 7.33 and 7.26 (m each, 6:1 H), 5.13 (s, 1 H), 4.85 (q, J = 6.8 Hz, 1 H), 2.33 (s, 3 H), 1.61 (d, J = 6.8 Hz, 3 H). $^{13}C\{^1H\}$

NMR (100 MHz, $CDCl_3$) δ 182.2, 169.4, 143.2, 134.8, 134.5, 136.2, 127.4 , 129.1, 129.0, 128.9, 128.8, 125.9, 91.7, 54.3, 24.5, 14.5. HRMS (EI) calcd for $C_{20}H_{21}NOSCl$ $[M+H]^+$: 358.1032; Found: 358.1033. HPLC (AD-H column, *i*PrOH/hexane 3/97, 0.7 mL/min, 254 nm): t_1 = 10.0 min (major), t_2 = 11.1 min.

(*E*)-3-(((1R,4aS,10aR)-7-isopropyl-1,4a-dimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-1-yl)methylamino)-3-(thiomethyl)-1-phenylprop-2-en-1-one (1z13): 489 mg, yield 53%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.31 (br s, 1 H), 7.93, 7.46, 7.26 (m each, 2:3:1 H), 7.08 (d, J = 8.1 Hz, 1 H), 6.99 (s, 1 H), 5.73 (d, J = 2.1 Hz, 1 H), 3.46 (dd, J = 13.0 and 6.3 Hz, 1 H), 3.31 (dd, J = 13.1 and 5.8 Hz, 1 H), 3.03 (s, 2 H), 2.91 (m, 1 H), 2.51 (s, 3 H), 2.39 (d, J = 12.8 Hz, 1 H), 1.92 (dd, J = 10.5 and 7.0 Hz, 2 H), 1.84 (d, J = 11.7 Hz, 2 H), 1.80 (s, 1 H), 1.66 (d, J = 11.4 Hz, 1 H), 1.56 (s, 1 H), 1.53 (d, J = 2.3 Hz, 2 H), 1.33, 1.31 (3:3 H), 1.14 (s, 3 H), 0.97 (m, 1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 185.2, 169.9, 147.0, 145.6, 140.8, 134.6, 130.4, 128.2, 126.9, 126.8, 124.3, 123.9, 86.5, 56.1, 46.4, 38.2, 38.0, 37.6, 36.4, 33.5, 30.3, 26.9, 25.5, 24.0, 19.4, 18.7, 18.3, 14.4. HRMS (EI) calcd for $C_{30}H_{40}NOS$ $[M+H]^+$: 462.2831; Found: 462.2833.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2a): 123 mg, yield 72%, white solid, mp 101-104 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53, 7.37, 7.30 (m each, 2:7:1 H), 6.73 (br s, 1 H), 4.53 (d, J = 6.0 Hz, 2 H), 2.21 (s, 3 H), 1.98 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.4, 164.2, 148.8, 138.2, 134.3, 129.7, 128.9, 128.8, 128.21, 128.20, 127.8, 122.2, 43.9, 20.8, 17.0. HRMS (EI) calcd for $C_{19}H_{20}NO_3S$ $[M+H]^+$: 342.1164; Found: 342.1160.

(*E*)-3-(Methylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2b): 80 mg, yield 60%, white solid, mp 106-109 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54, 7.37 (m each, 2:3 H), 6.46 (br s, 1 H), 2.91 (d, J = 5.0 Hz, 3 H), 2.21 (s, 3 H), 2.17 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.4, 165.0, 149.2, 134.4, 129.6, 128.8, 128.2, 122.1, 26.7, 21.0, 17.1. HRMS (EI) calcd for $C_{13}H_{15}NO_3SNa$ $[M+Na]^+$: 288.0670; Found: 288.0670.

(*E*)-3-(Ethylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2c): 116 mg, yield 83%, white solid, mp 109-112 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52, 7.34

(m each, 2:3 H), 6.42 (br s, 1 H), 3.35 (p, J = 6.9 Hz, 2 H), 2.19 (s, 3 H), 2.13 (s, 3 H), 1.16 (t, J = 7.2 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.2, 164.0, 147.8, 134.2, 129.4, 128.6, 128.0, 122.5, 34.6, 20.9, 16.7, 14.9. HRMS (EI) calcd for $C_{14}H_{17}NO_3SNa$ $[M+Na]^+$: 302.0827; Found: 302.0824.

(*E*)-3-(Ethylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate-^{13}C (2c[^{13}C]): 104 mg, yield 74%, white solid, mp 118-121 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.53, 7.36 (m each, 2:3 H), 6.41 (br s, 1 H), 3.37 (m, 2 H), 2.21 (s, 3 H), 2.15 (s, 3 H), 1.18 (t, J = 7.2 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.4 (d, J = 4.2 Hz), 164.1, 148.1, 134.2 (d, J = 67.7 Hz), 129.6 (d, J = 0.9 Hz), 128.7 (d, J = 1.6 Hz), 128.2 (d, J = 4.5 Hz), 122.5 (d, J = 91.8 Hz), 34.7, 21.0 (d, J = 1.9 Hz), 16.8 (d, J = 2.3 Hz), 15.0. ^{13}C DEPT135 NMR (100 MHz, $CDCl_3$) δ 148.0, 129.5 (d, J = 0.9 Hz), 128.6 (d, J = 1.7 Hz), 128.1 (d, J = 4.5 Hz), 34.6, 20.9 (d, J = 2.0 Hz), 16.8 (d, J = 2.3 Hz), 14.9. HRMS (EI) calcd for $C_{13}{}^{13}CH_{17}NO_3SNa$ $[M+Na]^+$: 303.0860; Found: 303.0856.

(*E*)-3-(Butylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2d): 132 mg, yield 86%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.52, 7.35 (m each, 2:3 H), 6.41 (br s, 1 H), 3.32 (q, J = 6.6 Hz, 2 H), 2.20 (d, J = 0.6 Hz, 3 H), 2.14 (d, J = 0.6 Hz, 3 H), 1.52 (m, 2 H), 1.37 (m, 2 H), 0.93 (t, J = 7.2 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.3, 164.1, 147.9, 134.2, 129.5, 128.6, 128.1, 122.5, 39.5, 31.7, 20.9, 20.1, 16.8, 13.7. HRMS (EI) calcd for $C_{16}H_{22}NO_3S$ $[M+H]^+$: 308.1320; Found: 308.1316.

(*E*)-3-(Cyclohexylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2e): 132 mg, yield 79%, white solid, mp 120-121^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.53 (dd, J = 7.6 and 1.9 Hz, 2 H), 7.34 (m, 3 H), 6.22 (d, J = 8.0 Hz, 1 H), 3.85 (m, 1 H), 2.21 (s, 3 H), 2.14 (s, 3 H), 1.93, 1.71, 1.61, 1.38, 1.18 (m each, 2:2:1:2:3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.4, 163.0, 146.9, 134.1, 129.4, 128.6, 128.1, 122.9, 48.4, 33.1, 25.5 24.8, 20.9, 16.5. HRMS (EI) calcd for $C_{18}H_{24}NO_3S$ $[M+H]^+$: 334.1477; Found: 334.1481.

(*E*)-2-(Thiomethyl)-3-oxo-1-phenyl-3-(1-phenylethylamino)prop-1-enyl acetate (2f): 151 mg, yield 85%, white solid, mp 128-131 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ

7.56, 7.39, 7.30 (m each, 3:6:1 H), 6.63 (d, J = 7.9 Hz, 1 H), 5.27 (m, 1 H), 2.21 (s, 3 H), 1.99 (s, 3 H), 1.57 (d, J = 6.9 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.4, 163.2, 147.4, 142.8 134.1, 129.5, 128.8, 128.6, 128.1, 127.6, 126.4, 122.6, 49.0, 21.8, 20.7, 16.6. HRMS (EI) calcd for $C_{20}H_{22}NO_3S$ $[M+H]^+$: 356.1320; Found: 356.1314.

(*Z*)-3-(Benzhydrylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2g): 188 mg, yield 90%, white solid, mp 128-130 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.88, 7.71, 7.62 (m each, 2:7:6 H), 7.34 (d, J = 8.7 Hz, 1 H), 6.73 (d, J = 8.7 Hz, 1 H), 2.52 (s, 3 H), 2.22 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.6, 163.5, 148.2, 141.4, 128.9, 128.8, 128.2, 127.7 127.6, 134.2 129.7, 122.4, 57.0, 20.7, 16.9. HRMS (EI) calcd for $C_{25}H_{24}NO_3S$ $[M+H]^+$: 418.1477; Found: 418.1472.

(*E*)-3-(allylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2h): 108 mg, yield 74%, white solid, mp 89-92 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.54, 7.39 (m each, 2:3 H), 6.51 (br s, 1 H), 5.88 (m, 1 H), 5.26 (dd, J = 17.2 and 1.4 Hz, 1 H), 5.19 (dd, J = 10.2 and 1.2 Hz, 1 H), 3.98 (m, 2 H), 2.23 (s, 3 H), 2.16 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.4, 164.2, 149.1, 134.3, 133.9 117.1, 129.7, 128.8, 128.2, 122.1, 42.3, 21.1, 17.1. HRMS (EI) calcd for $C_{15}H_{17}NO_3SNa$ $[M+Na]^+$: 314.0827; Found: 314.0823.

(*E*)-2-(Thiomethyl)-3-oxo-1-phenyl-3-((tetrahydrofuran-2-yl)methylamino)prop-1-enyl acetate (2i): 141 mg, yield 84%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.52, 7.35 (m each, 2:3 H), 6.76 (br s, 1 H), 3.85 3.73 (dd, J = 15.0 and 7.0 Hz, 1:1 H), 3.99 (m, 1 H), 3.62, 3.21 (m each, 1:1 H), 1.97, 1.87, 1.55 (m each, 1:2:1 H), 2.20 (s, 3 H), 2.14 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.1, 164.3, 149.0, 134.4, 129.5, 128.7, 128.1, 122.2, 77.5, 68.1, 28.8, 25.8, 43.6, 20.9, 16.9. HRMS (EI) calcd for $C_{17}H_{22}NO_4S$ $[M+H]^+$: 336.1270; Found: 336.1275.

(*Z*)-3-(Furan-2-ylmethylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2j): 121 mg, yield 73%, white solid, mp 99-102 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.54, 7.37 (m each, 1:4 H), 7.53, 6.33 (d, J = 1.9 Hz, 1:1 H), 6.72 (br s, 1 H), 6.29 (d, J = 3.1 Hz, 1 H), 4.52 (d, J = 5.8 Hz, 2 H), 2.19 (s, 3 H), 2.07 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.4, 164.0, 151.1, 148.8, 142.4, 110.7, 107.9, 134.2, 129.6, 128.7, 128.2, 122.0, 36.7, 20.8, 16.8. HRMS (EI) calcd for $C_{17}H_{17}NO_4SNa$

$[M+Na]^+$: 354.0776; Found: 354.0773.

(*E*)-3-(Benzylamino)-1-(2-chlorophenyl)-2-(thiomethyl)-3-oxoprop-1-enyl acetate (2k): 158 mg, yield 84%, white solid, mp 117-119 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49, 7.42, 7.36, 7.31, 7.27 (m each, 1:1:4:2:1 H), 6.85 (br s, 1 H), 4.55 (d, J = 6.0 Hz, 2 H), 2.19 (s, 3 H), 1.99 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.9, 163.5, 148.0, 138.2, 133.7, 133.6, 131.6, 130.7, 129.8, 129.0, 128.2, 127.8, 126.7, 124.9, 44.0, 20.8, 16.9. HRMS (EI) calcd for $C_{19}H_{19}NO_3SCl$ $[M+H]^+$: 376.0774; Found: 376.0773.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-p-tolylprop-1-enyl acetate (2l): 144 mg, yield 81%, white solid, mp 139-142 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46, 7.20 (d each, J = 8.1 Hz, 2:2 H), 7.37, 7.32 (m each, 4:1 H), 6.75 (s, 1 H), 4.55 (d, J = 6.0 Hz, 2 H), 2.38 (s, 3 H), 2.24 (s, 3 H), 2.00 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.5, 164.4, 149.2, 139.9, 138.2, 131.4, 128.94, 128.92, 128.7, 128.2, 127.8, 121.5, 43.9, 21.6, 20.8, 17.1. HRMS (EI) calcd for $C_{20}H_{22}NO_3S$ $[M+H]^+$: 356.1320; Found: 356.1327.

(*E*)-3-(Benzylamino)-1-(4-chlorophenyl)-2-(thiomethyl)-3-oxoprop-1-enyl acetate (2m): 162 mg, yield 86%, white solid, mp 148-151 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (d, J = 8.5 Hz, 2 H), 7.34, 7.28 (m, 6:1 H), 6.72 (br s, 1 H), 4.51 (d, J = 6.1 Hz, 2 H), 2.21 (s, 3 H), 1.97 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.3, 163.9, 147.3, 138.1, 135.5, 132.6, 130.1, 128.9, 128.5, 128.2, 127.8, 122.9, 43.9, 20.7, 16.9. HRMS (EI) calcd for $C_{19}H_{19}NO_3SCl$ $[M+H]^+$: 376.0774; Found: 376.0765.

(*E*)-3-(Ethylamino)-1-(3-fluorophenyl)-2-(thiomethyl)-3-oxoprop-1-enyl acetate (2n): 103 mg, yield 69%, white solid, mp 93-96 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32, 7.25, 7.03 (m each, 2:1:1 H), 6.37 (br s, 1 H), 3.36 (m, 2 H), 2.22 (s, 3 H), 2.15 (s, 3 H), 1.16 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.3, 163.7, 162.3 (d, J = 246.4 Hz), 145.8 (d, J = 2.5 Hz), 136.1 (d, J = 8.0 Hz), 129.8 (d, J = 8.3 Hz), 124.4 (d, J = 3.0 Hz), 116.4 (d, J = 21.2 Hz), 115.6 (d, J = 23.1 Hz), 123.7, 34.7, 20.8, 16.6, 14.9. HRMS (EI) calcd for $C_{14}H_{16}NO_3SFNa$ $[M+Na]^+$: 320.0733; Found: 320.0731.

***N*-Acetyl-*N*-ethyl-3-(3-fluorophenyl)-2-(thiomethyl)-3-oxopropanamide (2n′):**

82 mg, yield 92%, white solid, mp 60-63 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, J = 7.7 Hz, 1 H), 7.68 (d, J = 9.5 Hz, 1 H), 7.44 (dd, J = 13.6 and 7.9 Hz, 1 H), 7.24 (m, 1 H), 5.91 (s, 1 H), 3.81 (q, J = 7.1 Hz, 2 H), 2.24 2.07 (s each, 3:3 H), 1.25 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 188.2 (d, J = 2.2 Hz), 173.4, 168.9, 162.8 (d, J = 247.4 Hz), 137.6 (d, J = 6.5 Hz), 130.3 (d, J = 7.7 Hz), 124.6 (d, J = 3.0 Hz), 120.1 (d, J = 21.4 Hz), 115.6 (d, J = 22.7 Hz), 56.8, 41.1, 24.8, 14.0, 13.9. HRMS (EI) calcd for $C_{14}H_{16}NO_3SFNa$ $[M+Na]^+$: 320.0733; Found: 320.0722.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-1-(naphthalen-2-yl)-3-oxoprop-1-enyl acetate (2o): 156 mg, yield 80%, white solid, mp 125 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (s, 1 H), 7.84 (t, J = 7.5 Hz, 3 H), 7.67 (dd, J = 8.6 and 1.5 Hz, 1 H), 7.51, 7.33 (m each, 2:5 H), 6.81 (br s, 1 H), 4.56 (d, J = 6.0 Hz, 2 H), 2.24 (s, 3 H), 2.02 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.5, 164.2, 148.8, 138.2, 133.7, 132.7, 131.6, 128.9, 128.8, 128.6, 128.2, 127.9, 127.8, 127.3, 126.6, 125.7, 122.5, 43.9, 20.8, 17.0. HRMS (EI) calcd for $C_{23}H_{22}NO_3S$ $[M+H]^+$: 392.1320; Found: 392.1317.

***N*-Acetyl-*N*-benzyl-2-(thiomethyl)-3-(naphthalen-2-yl)-3-oxopropanamide (2o′):** 10 mg, yield 5%, white solid, mp 109-112 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63 (s, 1 H), 8.08 (dd, J = 8.6 and 1.6 Hz, 1 H), 7.98, 7.89 (d each, J = 8.1 Hz, 1:1 H), 7.93 (d, J = 8.7 Hz, 1 H), 7.58, 7.38 (m each, 2:2 H), 7.31 (s, 1 H), 7.29 (d, J = 2.1 Hz, 2 H), 6.26 (s, 1 H), 5.28, 4.94 (d each, J = 16.8 Hz, 1:1 H), 2.18 (s, 3 H), 2.16 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 189.9, 174.1, 170.2, 136.4, 135.8, 132.8, 132.7, 130.7, 129.9, 129.2, 128.6, 128.5, 127.9, 127.7, 126.8, 126.3, 124.6, 56.9, 48.6, 25.4, 14.1. HRMS (EI) calcd for $C_{23}H_{22}NO_3S$ $[M+H]^+$: 392.1320; Found: 392.1315.

(*E*)-3-(Ethylamino)-2-(thiomethyl)-3-oxo-1-(4-(trifluoromethyl)phenyl)prop-1-enyl acetate (2p): 95 mg, yield 55%, white solid, mp 101-103 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65, 7.60 (d each, J = 8.5 Hz, 2:2 H), 6.38 (br s, 1 H), 3.37 (m, 2 H), 2.23 (s, 3 H), 2.15 (s, 3 H), 1.17 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.3, 163.5, 145.9, 137.7, 131.1 (q, J = 32.6 Hz), 129.0, 125.2 (q, J = 3.8 Hz), 124.4, 123.8 (q, J = 270.6 Hz), 34.7, 20.8, 16.5, 14.9. HRMS (EI) calcd for $C_{15}H_{17}NO_3SF_3$ $[M+H]^+$: 348.0881; Found: 348.0876.

1-(Ethylamino)-2-(thiomethyl)-1,3-dioxo-3-(4-(trifluoromethyl)phenyl)propan-

2-yl acetate (2p′′): 33 mg, yield 18%, white solid, mp 133-136 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15, 7.67 (d each, J = 8.2 Hz, 2:2 H), 7.37 (br s, 1 H), 3.38 (m, 2 H), 2.28 (s, 3 H), 2.02 (s, 3 H), 1.19 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 193.1, 169.9, 163.5, 137.6, 134.5 (q, J = 32.9 Hz), 129.6, 125.4 (q, J = 3.7 Hz), 124.9, 122.2 (q, J = 271.1 Hz), 88.8, 35.4, 20.8, 14.8, 13.0. HRMS (EI) calcd for $C_{15}H_{16}NO_4SF_3Na$ $[M+Na]^+$: 386.0650; Found: 386.0652.

(*E*)-3-(Ethylamino)-1-(furan-2-yl)-2-(thiomethyl)-3-oxoprop-1-enyl acetate (2q): 102 mg, yield 76%, white solid, mp 91-94 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 (d, J = 1.7 Hz, 1 H, furyl CH), 6.93 (d, J = 3.5 Hz, 1 H), 6.46 (dd, J = 3.5 and 1.8 Hz, 1 H), 6.29 (br s, 1 H), 3.34 (m, 2 H), 2.30 (s, 3 H), 2.23 (s, 3 H), 1.15 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.7, 163.3, 146.6, 137.3, 121.1, 143.2, 113.9, 111.9, 34.7, 20.7, 16.3, 15.0. HRMS (EI) calcd for $C_{12}H_{15}NO_4SNa$ $[M+Na]^+$: 292.0619; Found: 292.0613.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-(thiophen-2-yl)prop-1-enyl acetate (2r): 118 mg, yield 68%, white solid, mp 90-93 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 (dd, J = 3.8 1.2 Hz, 1 H), 7.43 (dd, J = 5.1 and 1.2 Hz, 1 H), 7.35, 7.29 (m each, 4:1 H), 7.03 (dd, J = 5.1 and 3.9 Hz, 1 H), 6.90 (br, J = 5.0 Hz, 1 H), 4.51 (d, J = 6.0 Hz, 2 H), 2.31 (s, 3 H), 2.12 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.2, 164.0, 145.2, 138.2 136.0, 130.4, 129.9, 128.9, 128.1, 127.7, 126.9, 118.7, 43.9, 20.8, 17.4. HRMS (EI) calcd for $C_{17}H_{18}NO_3S_2$ $[M+H]^+$: 348.0728; Found: 348.0732.

(*E*)-3-(Ethylamino)-2-(thioethyl)-3-oxo-1-phenylprop-1-enyl acetate (2s): 117 mg, yield 80%, white solid, mp 74-76 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54, 7.36 (m each, 2:3 H), 6.44 (br s, 1 H), 3.37 (m, 2 H), 2.66 (q, J = 7.4 Hz, 2 H), 2.17 (s, 3 H), 1.23 (t, J = 7.4 Hz, 3 H), 1.19 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.3, 164.6, 149.8, 134.4, 129.5, 129.0, 128.1, 121.1, 34.7, 28.2, 21.0, 14.9, 14.7. HRMS (EI) calcd for $C_{15}H_{20}NO_3S$ $[M+H]^+$: 294.1164; Found: 294.1163.

(*E*)-2-(Thioethyl)-3-oxo-1-phenyl-3-(1-phenylethylamino)prop-1-enyl acetate (2t): 155 mg, yield 84%, white solid, mp 113-115 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54, 7.36, 7.28 (m each, 2:7:1 H), 6.63 (d, J = 8.1 Hz, 1 H), 5.23 (p, J = 7.1 Hz, 1 H), 2.63 (q, 2 H), 1.98 (s, 3 H), 1.54 (d, J = 6.9 Hz, 3 H), 1.20 (t, J = 7.2 Hz, 3 H). ^{13}C{^{1}H}

NMR (100 MHz, $CDCl_3$) δ 169.4, 163.7, 149.2, 142.9 134.2, 129.5, 128.9, 128.8, 128.1, 127.6, 126.4, 121.2, 49.0, 28.0, 21.7, 20.8, 14.7. HRMS (EI) calcd for $C_{21}H_{24}NO_3S$ $[M+H]^+$: 370.1477; Found: 370.1471.

(*E*)-2-(Benzylthio)-3-(ethylamino)-3-oxo-1-phenylprop-1-enyl acetate (2u): 94 mg, yield 53%, colorless liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.28, 7.23 (m each, 7:3 H), 6.33 (br s, 1 H), 3.82 (s, 2 H, SCH_2), 3.29 (m, 2 H), 2.14 (s, 3 H), 1.13 (t, J = 7.2 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.1, 164.6, 152.1, 137.0 134.4, 129.5, 129.2, 128.9, 128.7, 128.0, 127.5, 120.3, 38.9, 34.7, 21.0, 14.9. HRMS (EI) calcd for $C_{20}H_{22}NO_3S$ $[M+H]^+$: 356.1320; Found: 356.1319.

2-(*T*hiobenzyl)-1-(ethylamino)-1,3-dioxo-3-phenylpropan-2-yl acetate (2u′′): 61 mg, yield 33%, white solid, mp 152-154 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, J = 7.3 Hz, 2 H), 7.52, 7.37, 7.26, 7.32 (m each, 1:4:1:2 H), 7.41 (br s, 1 H), 4.09, 3.95 (d each, J = 12.9 Hz, 1:1 H), 3.34 (m, 2 H), 1.85 (s, 3 H), 1.18 (t, J = 7.2 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 193.8, 169.7, 164.1, 136.4 134.6, 133.4, 129.4, 129.3, 128.8, 128.4, 127.6, 89.7, 35.3, 35.1, 20.7, 14.7. HRMS (EI) calcd for $C_{20}H_{21}NO_4SNa$ $[M+Na]^+$: 394.1089; Found: 394.1085.

(1*E*,3*E*)-5-(Benzylamino)-4-(thiomethyl)-5-oxo-1-p-tolylpenta-1,3-dien-3-yl acetate (2v): 156 mg, yield 82%, white solid, mp 116-118 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.49, 6.84 (d each, J = 15.9 Hz, 1:1 H), 7.39, 7.16 (d, J = 8.0 Hz, 2:2 H), 7.30 (m, 5 H), 7.11 (t, 1 H), 4.51 (d, J = 5.9 Hz, 2 H), 2.36 (s, 3 H), 2.26 (s, 3 H), 2.23 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.9, 163.9, 152.1, 139.5, 138.2, 133.1, 135.2, 119.6, 129.6, 128.8, 128.0, 127.7, 127.6, 120.1, 43.9, 21.5, 20.9, 18.0. HRMS (EI) calcd for $C_{22}H_{24}NO_3S$ $[M+H]^+$: 382.1477; Found: 382.1482.

(1*E*,3*E*)-5-(Benzylamino)-1-(4-methoxyphenyl)-4-(thiomethyl)-5-oxopenta-1,3-dien-3-yl acetate (2w): 153 mg, yield 77%, white solid, mp 130-131 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.42 (m, 3 H), 7.31 (m, 5 H), 7.12 (br s, 1 H), 6.88 (d, J = 8.5 Hz, 2 H), 6.82 (d, J = 15.8 Hz, 1 H), 4.51 (d, J = 5.9 Hz, 2 H), 3.82 (s, 3 H), 2.25 (d, J = 7.9 Hz, 3:3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.9, 164.0, 160.7, 152.7, 138.3 128.7, 135.0, 118.6, 129.2, 128.9, 128.0, 127.7, 114.4, 119.2, 55.5, 44.0, 21.0, 18.2. HRMS (EI) calcd for $C_{22}H_{24}NO_4S$ $[M+H]^+$: 398.1426; Found: 398.1424.

(1*E*,3*E*)-5-(Benzylamino)-4-(thiomethyl)-5-oxo-1-(thiophen-2-yl)penta-1,3-dien -3-yl acetate (2x): 142 mg, yield 76%, yellow solid, mp 113-115 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (d, J = 3.3 Hz, 1 H), 7.30 (m, 6 H), 7.13 (d, J = 3.3 Hz, 2 H), 6.99 (m, 2 H), 4.49 (d, J = 5.9 Hz, 2 H), 2.24 (s, 3 H), 2.22 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.7, 163.7, 151.5, 141.3 138.2, 128.8, 119.9, 128.7, 128.0, 127.9, 127.8, 127.6, 127.1, 120.1, 43.8, 20.9, 18.0. HRMS (EI) calcd for $C_{19}H_{20}NO_3S_2$ $[M+H]^+$: 374.0885; Found: 374.0883.

(*E*)-4-(Benzylamino)-3-(thiomethyl)-4-oxobut-2-en-2-yl acetate (2y): 92 mg, yield 66%, white solid, mp 62-65 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (m, 5 H), 6.78 (br s, 1 H), 4.47 (d, J = 6.0 Hz, 2 H), 2.21 (s, 3 H), 2.19 (s, 3 H), 2.03 (s, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.0, 164.0, 153.7, 138.3, 128.9, 128.0, 127.7, 119.9, 43.8, 20.9, 19.6, 17.3. HRMS (EI) calcd for $C_{14}H_{18}NO_3S$ $[M+H]^+$: 280.1007; Found: 280.1002.

(*E*)-3-(Thiomethyl)-4-oxo-4-(4-(trifluoromethyl)benzylamino)but-2-en-2-yl acetate (2z): 109 mg, yield 63%, white solid, mp 68-70 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58, 7.41 (d each, J = 8.1 Hz, 2:2 H), 6.96 (br s, 1 H), 4.52 (d, J = 6.2 Hz, 2 H), 2.21, 2.20, 2.05 (s each, 3:3:3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.9, 164.2, 154.7, 142.4, 130.0 (q, J = 32.4 Hz), 128.1, 125.8 (q, J = 3.7 Hz), 124.2 (q, J = 271.9 Hz), 119.4, 43.2, 20.9, 19.7, 17.5. HRMS (EI) calcd for $C_{15}H_{17}NO_3SF_3$ $[M+H]^+$: 348.0881; Found: 348.0881.

(*E*)-3-(Thiomethyl)-4-oxo-4-(1-phenylethylamino)but-2-en-2-yl acetate (2z1): 108 mg, yield 74%, white solid, mp 77-79 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32, 7.25 (m each, 4:1 H), 6.60 (d, J = 7.7 Hz, 1 H), 5.16 (m, 1 H), 2.17, 2.14 (s each, 3:3 H), 1.99 (s, 3 H), 1.49 (d, J = 6.9 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.0, 163.1, 152.1, 143.0, 128.8, 127.5, 126.3, 120.4, 48.8, 21.8, 20.8, 19.1, 16.9. HRMS (EI) calcd for $C_{15}H_{20}NO_3S$ $[M+H]^+$: 294.1164; Found: 294.1165.

(*E*)-3-(Diethylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2z2): 121 mg, yield 79%, white solid, mp 62-65 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55, 7.36 (m each, 2:3 H), 3.57, 3.37 (m each, 2:2 H), 2.21 (s, 3 H), 2.10 (s, 3 H), 1.24, 1.19 (t each, J = 7.1 Hz, 3:3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.8, 163.9,

142.8, 133.7, 129.2, 128.3, 128.2, 122.1, 42.9, 38.6, 20.7, 15.9, 13.8, 12.9. HRMS (EI) calcd for $C_{16}H_{22}NO_3S$ $[M+H]^+$: 308.1320; Found: 308.1319.

(*E*)-3-(Diethylamino)-2-(thiomethyl)-3-oxo-1-p-tolylprop-1-enyl acetate (2z3): 116 mg, yield 72%, white solid, mp 54-57 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.43, 7.18 (d each, J = 8.1 Hz, 2:2 H), 3.64, 3.32 (m each, 2:2 H), 2.34 (s, 3 H), 2.20 (s, 3 H), 2.09 (s, 3 H), 1.23, 1.18 (m each, 3:3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.8, 164.0, 143.1, 139.3, 130.8, 128.9, 128.2, 121.3, 42.9 38.5, 21.5, 20.7, 16.0, 13.8 12.9. HRMS (EI) calcd for $C_{17}H_{24}NO_3S$ $[M+H]^+$: 322.1477; Found: 322.1472.

(*E*)-1-(4-Chlorophenyl)-3-(diethylamino)-2-(thiomethyl)-3-oxoprop-1-enyl acetate (2z4): 121 mg, yield 71%, white solid, mp 79-80 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.47, 7.32 (d each, J = 8.7 Hz, 2:2 H), 3.60, 3.31 (m each, 2:2 H), 2.20 (s, 3 H), 2.08 (s, 3 H), 1.21 1.16 (t each, 3:3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.7, 163.5, 141.5, 134.9, 132.1, 129.6, 128.4, 122.9, 42.8, 38.6, 20.6, 15.8, 13.7, 12.8. HRMS (EI) calcd for $C_{16}H_{21}NO_3SCl$ $[M+H]^+$: 342.0931; Found: 342.0931.

(1*E*,3*E*)-5-(3,5-Dichlorophenylamino)-4-(thioethyl)-1-(furan-2-yl)-5-oxopenta-1,3-dien-3-yl acetate (2z5): 113 mg, yield 53%, brow solid. mp 121-124 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.93 (br s, 1 H), 7.52 (m, 4 H, 1 H), 7.10 (t, 1 H), 6.76 (d, J = 15.6 Hz, 1 H), 6.53 (d, J = 3.3 Hz, 1 H), 6.46 (dd, J = 3.3 and 1.8 Hz, 1 H), 2.75 (q, J = 7.4 Hz, 2 H), 2.36 (s, 3 H), 1.33 (t, J = 7.2 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.6, 162.5, 156.6, 152.2, 139.8, 144.5, 135.4, 124.4, 123.8, 119.3, 118.1, 113.6, 112.6, 116.6, 30.2, 21.2, 14.7. HRMS (EI) calcd for $C_{19}H_{18}NO_4SCl_2$ $[M+H]^+$: 426.0334; Found: 426.0330.

(*E*)-3-((*Z*)-3,7-Dimethylocta-2,6-dienylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2z6): 120 mg, yield 62%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.53 (dd, J = 7.4 and 2.1 Hz, 2 H), 7.36 (m, 3 H), 6.34 (br s, 1 H), 5.22, 5.07 (m each, 1:1 H), 3.93 (t, J = 6.3 Hz, 2 H), 2.21, 2.15 (s each, 3:3 H), 2.08 (dd, J = 9.9 and 5.0 Hz, 2 H), 2.01 (m, 2 H), 1.69, 1.67, 1.59 (s each, 3:3:3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.3, 163.9, 148.1, 140.5, 134.2, 131.9, 129.5, 128.6, 128.1, 123.8, 119.5, 122.3, 39.6, 37.7, 26.4, 25.7, 20.9, 17.8, 16.8, 16.4. HRMS (EI) calcd for $C_{22}H_{30}NO_3S$ $[M+H]^+$: 388.1946; Found: 388.1944.

(1*E*,1'*E*)-3,3'-(Octane-1,8-diylbis(azanediyl))bis(2-(thiomethyl)-3-oxo-1-phenyl prop-1-ene-3,1-diyl) diacetate (2z7): 217 mg, yield 71%, white solid, mp 127-130 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54, 7.38 (m each, 4:6 H), 6.42 (s, 2 H), 3.33 (m, 4 H), 2.22 (s, 6 H), 2.16 (s, 6 H), 1.54 (m, 4 H), 1.35 (s, 8 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.4, 164.2, 148.4, 134.3, 129.6, 128.8, 128.2, 122.5, 39.9, 29.8, 29.3, 27.05, 21.1, 17.0. HRMS (EI) calcd for $C_{32}H_{41}N_2O_6S_2$ $[M+H]^+$: 613.2406; Found: 613.2405.

(*S*,*E*)-Methyl 2-(3-acetoxy-2-(thiomethyl)-3-phenylacrylamido)propanoate (2z8): 86 mg, yield 51%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53, 7.37 (m each, 2:3 H), 6.94 (d, J = 7.5 Hz, 1 H), 4.63 (p, J = 7.3 Hz, 1 H), 3.73 (s, 3 H), 2.23, 2.15 (s each, 3:3 H), 1.43 (d, J = 7.2 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 173.0, 169.3, 163.8, 149.5, 134.3, 129.7, 128.8, 128.2, 121.7, 52.6, 48.3, 21.0 18.3, 17.0. HRMS (EI) calcd for $C_{16}H_{20}NO_5S$ $[M+H]^+$: 338.1062; Found: 338.1064.

(*R*,*E*)-1-(4-Chlorophenyl)-2-(thiomethyl)-3-oxo-3-(1-phenylethylamino)prop-1-enyl acetate (2z9): 171 mg, yield 88%, white solid, mp 120-122 ^{o}C, 99% ee, $[\alpha]^{20}_{D}$ = -7.50 (*c* 1.00, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47, 7.33 (d each, J = 8.6 Hz, 2:2 H), 7.36 (d, J = 4.3 Hz, 4 H), 7.28 (m, 1 H), 6.55 (d, J = 8.3 Hz, 1 H), 5.23 (m, 1 H), 2.19 (s, 3 H), 1.95 (s, 3 H), 1.54 (d, J = 6.9 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.4, 162.9, 146.0, 142.7, 135.4, 132.5, 130.0, 128.9, 128.5, 127.7, 126.4, 123.3, 49.0, 21.8, 20.7, 16.5. HRMS (EI) calcd for $C_{20}H_{21}NO_3SCl$ $[M+H]^+$: 390.0931; Found: 390.0930. HPLC (OG-H column, *i*PrOH/hexane 2/98, 0.7 mL/min, 254 nm): t_1 = 34.3 min (major), t_2 = 41.3 min.

(*S*,*E*)-2-(Thiomethyl)-3-oxo-3-(1-phenylethylamino)-1-(thiophen-2-yl)prop-1-enyl acetate (2z10): 132 mg, yield 73%, white solid, mp 89-92 ^{o}C, 99% ee, $[\alpha]^{20}_{D}$ = 10.10 (*c* 1.01, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.4 (dt, J = 5.2 and 1.2 Hz, 2 H), 7.38 (d, J = 4.4 Hz, 4 H), 7.31 (dq, J = 8.7 and 4.4 Hz, 1 H), 7.05 (dd, J = 5.1 and 3.9 Hz, 1 H), 6.74 (d, J = 8.2 Hz, 1 H), 5.24 (dq, J = 14.0 and 7.0 Hz, 1 H), 2.31 (s, 3 H), 2.12 (s, 3 H), 1.55 (d, J = 6.9 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.3, 163.0, 143.6, 142.8 136.0, 130.0, 129.4, 128.8, 127.6, 126.9, 126.3, 119.6, 49.1, 21.8, 20.7, 17.0. HRMS (EI) calcd for $C_{18}H_{20}NO_3S_2$ $[M+H]^+$: 362.0885; Found: 362.0882.

HPLC (OG-H column, *i*PrOH/hexane 5/95, 0.9 mL/min, 254 nm): t_1 = 25.9 min, t_2 = 28.3 min (major).

(*1E,3E*)-4-(Thiomethyl)-5-oxo-5-((*S*)-1-phenylethylamino)-1-o-tolylpenta-1,3-dien-3-yl acetate (2z11): 144 mg, yield 73%, yellow solid, mp 66-69 ^{o}C, 99% ee, $[\alpha]^{20}_{D}$ = -3.20 (*c* 0.50, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56, 7.20, 7.16 (m, 1:2:1 H), 7.36 (m, 5 H), 7.28 (dd, *J* = 8.8 and 4.4 Hz, 1 H), 7.06 (d, *J* = 15.8 Hz, 1 H), 6.88 (d, *J* = 8.2 Hz, 1 H), 5.22 (m, 1 H), 2.35 (s, 3 H), 2.25 (s, 3 H), 2.19 (s, 3 H), 1.54 (d, *J* = 6.9 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.9, 163.0, 150.3, 142.9, 136.5, 134.9, 132.1, 127.6, 130.7, 128.9, 128.8, 126.4, 126.3, 126.2, 121.4, 121.6, 49.0, 21.8, 20.8, 19.8, 17.5. HRMS (EI) calcd for $C_{23}H_{26}NO_3S$ $[M+H]^+$: 396.1633; Found: 396.1638. HPLC (OD-H column, *i*PrOH/hexane 30/70, 0.7 mL/min, 230 nm): t_1 = 5.6 min (major), t_2 = 7.9 min.

(*1E,3E*)-1-(4-Chlorophenyl)-4-(thiomethyl)-5-oxo-5-((*R*)-1-phenylethylamino)penta-1,3-dien-3-yl acetate (2z12): 156 mg, yield 75%, yellow solid, mp 124-126 ^{o}C, 99% ee, $[\alpha]^{20}_{D}$ = 24.6 (*c* 0.50, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34, 6.64 (d, *J* = 15.9 Hz, 1:1 H), 7.31 (d, *J* = 6.5 Hz, 2 H), 7.26, 7.19 (m, 4:1 H), 7.22 (d, *J* = 8.5 Hz, 2 H), 6.76 (d, *J* = 8.3 Hz, 1 H), 5.12 (m, 1 H), 2.16 (s, 3 H), 2.09 (s, 3 H), 1.45 (d, *J* = 6.9 Hz, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 169.0, 162.9, 149.8, 142.9, 134.8, 134.5, 132.9, 127.3, 129.1, 128.9, 128.7, 126.4, 120.9, 122.3, 49.0, 21.8, 20.9, 17.5. HRMS (EI) calcd for $C_{22}H_{23}NO_3SCl$ $[M+H]^+$: 416.1087; Found: 416.1087. HPLC (OG-H column, *i*PrOH/hexane 20/80, 0.7 mL/min, 254 nm): t_1 = 11.3 min (major), t_2 = 14.3 min.

(*E*)-3-(((1R,4aS,10aR)-7-isopropyl-1,4a-dimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-1-yl)methylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl acetate (2z13): 202 mg, yield 78%, colorless liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (dd, *J* = 6.5, 3.0 Hz, 2 H), 7.39, 7.01 (m each, 3:1 H), 6.93 (s, 1 H), 7.19 (d, *J* = 8.2 Hz, 1 H), 6.50 (m, 1 H), 3.31 (m, 2 H), 2.95 (dd, *J* = 9.5 and 6.9 Hz, 2 H), 2.85 (dt, *J* = 13.8 and 6.9 Hz, 1 H), 2.34 (d, *J* = 12.8 Hz, 1 H), 2.20 (s, 3 H), 2.01 (d, *J* = 1.2 Hz, 1 H), 1.98 (s, 3 H), 1.82 (dd, *J* = 11.6 and 8.6 Hz, 2 H), 1.74 (m, 2 H), 1.51 (dt, *J* = 10.4 and 7.8 Hz, 2 H), 1.45 (d, *J* = 10.0 Hz, 2 H), 1.37 (m, 2 H), 1.29 (d, *J* = 10.7 Hz,

2 H), 1.27 (s, 3 H), 1.25 (d, *J* = 3.9 Hz, 3 H), 1.22 (d, *J* = 11.2 Hz, 3 H), 1.01 (d, *J* = 3.0 Hz, 3 H), 0.98 (m, 1 H), 0.91 (m, 2 H), 0.85 (m, 1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 169.3, 164.5, 148.5, 147.0, 145.7, 134.8, 134.2, 129.5, 128.7, 128.0, 126.9, 124.2, 123.9, 122.3, 50.6, 45.7, 38.4, 37.5, 37.4, 36.2, 33.5, 30.1, 25.3, 24.04, 24.02, 20.7, 19.1, 18.6, 26.9 17.1. HRMS (EI) calcd for $C_{32}H_{42}NO_3S$ $[M+H]^+$: 520.2885; Found: 520.2882.

(*E*)-3-(Allylamino)-2-(thiomethyl)-3-oxo-1-phenylprop-1-enyl pivalate (2z14): 103 mg, yield 62%, white solid, mp 131-132 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.52, 7.36 (m each, 2:3 H), 6.30 (s, 1 H), 5.85 (m, 1 H), 5.23 (d, *J* = 17.2 Hz, 1 H), 5.16 (d, *J* = 10.2 Hz, 1 H), 3.94 (td, *J* = 5.7 and 1.3 Hz, 2 H), 2.23 (s, 3 H), 1.22 (s, 9 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 176.9, 164.2, 147.3, 133.9, 133.7, 117.1, 129.5, 128.6, 128.1, 122.2, 42.2, 38.9, 26.9, 16.7. HRMS (EI) calcd for $C_{18}H_{24}NO_3S$ $[M+H]^+$: 334.1477; Found: 334.1476.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3a): 186 mg, yield 77%, white solid, mp 100-101 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.47 (br s, 1 H), 7.25 (m, 5 H), 5.15 (s, 1 H), 4.47 (d, *J* = 5.9 Hz, 2 H), 2.35 (s, 3 H), 1.64 (m, 1 H), 0.95, 0.70 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.3, 167.1, 137.6, 128.8, 127.6, 127.5, 89.7, 47.8, 20.2, 14.46, 8.91. HRMS (EI) calcd for $C_{14}H_{17}NOS$ $[M+H]^+$: 248.1109; Found: 248.1108.

(*E*)-3-(2-Methylbenzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3b): 254 mg, yield 80%, white solid, mp 114-115 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.48 (br s, 1 H), 7.34, 7.20 (m each, 1:3 H), 5.25 (s, 1 H), 4.52 (d, *J* = 5.7 Hz, 2 H), 2.42 (s, 3 H), 2.38(s, 3 H), 1.73 (m, 1 H), 1.03, 0.80 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 193.8, 166.7, 135.9, 135.1, 130.4, 127.9, 127.6, 126.1, 89.3, 45.7, 19.9, 18.9, 14.1, 8.7. HRMS (EI) calcd for $C_{15}H_{19}NOS$ $[M+H]^+$: 262.1266; Found: 262.1266.

(*E*)-3-(3-Methylbenzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3c): 210 mg, yield 80%, white solid, mp 111-112 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.49 (br s, 1 H), 7.21, 7.12 (m each, 1:3 H), 5.18 (s, 1 H), 4.45 (d, *J* = 5.8 Hz, 2 H), 2.33 (s, 3 H), 2.32 (s, 3 H) 1.68 (m, 1 H), 1.00, 0.72 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR

(100 MHz, $CDCl_3$) δ 193.8, 166.8, 138.2, 137.2, 128.5, 128.2, 127.9, 124.3, 89.3, 47.5, 21.3, 19.9, 14.1, 8.7. HRMS (EI) calcd for $C_{15}H_{19}NOS$ $[M+H]^+$: 262.1266; Found: 262.1266.

(*E*)-3-(4-Methylbenzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3d): 205 mg, yield 78%, white solid, mp 118-119 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 11.50 (br s, 1 H), 7.17, 7.12 (d each, J = 8.0 Hz, 2:2 H), 5.18 (s, 1 H), 4.44 (d, J = 5.9 Hz, 2 H), 2.34 (s, 3 H), 2.31 (s, 3 H), 1.70 (m, 1 H), 1.00, 0.72 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 193.7, 166.7, 136.9, 134.2, 129.2, 127.1, 89.3, 47.3, 20.9, 19.9, 14.1, 8.6. HRMS (EI) calcd for $C_{15}H_{19}NOS$ $[M+H]^+$: 262.1266; Found: 262.1266.

(*E*)-3-(2-Methoxylbenzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3e): 270 mg, yield 80%, white solid, mp 115-116 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 11.42 (br s, 1 H), 7.24, 6.90 (m each, 2:1 H), 6.82 (d, J = 8.1 Hz, 1 H), 5.15 (s, 1 H), 4.49 (d, J = 6.2 Hz, 2 H), 3.80 (s, 3 H), 2.32 (s, 3 H), 1.65 (m, 1 H), 0.97, 0.71 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 193.5, 166.8, 156.9, 125.4, 128.6, 128.2, 120.3, 110.1, 89.1, 55.2, 42.8, 19.9, 14.1, 8.5. HRMS (EI) calcd for $C_{15}H_{19}NO_2S$ $[M+H]^+$: 278.1215; Found: 278.1217.

(*E*)-3-(2-Fluorobenzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3f): 206 mg, yield 80%, white solid, mp 121-122 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 11.47 (br s, 1 H), 7.29, 7.21, 7.08, 7.01 (m, 1:1:1:1 H), 5.17 (s, 1 H), 4.53 (d, J = 6.1 Hz, 2 H), 2.35 (s, 3 H), 1.63 (m, 1 H), 1.00, 0.71 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.2, 166.6, 160.4 (d, J = 246.7 Hz), 115.3 (d, J = 21.1 Hz), 129.2 (d, J = 8.1 Hz), 129.1 (d, J = 4.0 Hz), 124.5 (d, J = 14.6 Hz), and 124.3 (d, J = 3.6 Hz), 89.8, 41.2 (d, J = 4.7 Hz), 20.1, 14.2, 8.8. HRMS (EI) calcd for $C_{14}H_{16}FNOS$ $[M+H]^+$: 266.1015; Found: 266.1014.

(*E*)-3-(2-Bromobenzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3g): 251 mg, yield 77%, white solid, mp 128-129 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 11.47 (br s, 1 H), 7.46 (d, J = 7.9 Hz, 1 H), 7.28 (m, 2 H), 7.06 (t, 1 H), 5.14 (s, 1 H), 4.50 (d, J = 6.3 Hz, 2 H), 2.30 (s, 3 H), 1.63 (m, 1 H), 0.92, 0.68 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.5, 167.1, 136.7, 123.1, 132.9, 129.1, 128.9,

127.8, 90.0, 47.9, 20.2, 14.4, 9.0. HRMS (EI) calcd for $C_{14}H_{16}BrNOS$ $[M+H]^+$: 326.0214; Found: 326.0212.

(*E*)-3-(3-Bromobenzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3h): 509 mg, yield 78%, white solid, mp 126-127 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.49 (br s, 1 H), 7.40, 7.37, 7.17 (m each, 1:1:2 H), 5.18 (s, 1 H), 4.44 (d, J = 6.2 Hz, 2 H), 2.35 (s, 3 H), 1.62 (m, 1 H), 0.89, 0.73 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.4, 166.8, 139.9, 122.7, 130.6, 130.3, 130.2, 125.8, 89.9, 46.9, 20.2, 14.3, 8.9. HRMS (EI) calcd for $C_{14}H_{16}BrNOS$ $[M+H]^+$: 326.0214; Found: 326.0218.

(*E*)-3-(4-Bromobenzylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3i): 515 mg, yield 79%, white solid, mp 128-129 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.50 (br s, 1 H), 7.42, 7.14 (d each, J = 8.3 Hz, 2:2 H), 5.18 (s, 1 H), 4.42 (d, J = 6.1 Hz, 2 H), 2.36 (s, 3 H), 1.65 (m, 1 H), 0.95, 0.73 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.4, 166.8, 136.6, 121.4, 131.8, 128.9, 89.9, 46.9, 20.1, 14.3, 8.9. HRMS (EI) calcd for $C_{14}H_{16}BrNOS$ $[M+H]^+$: 326.0214; Found: 326.0216.

(*E*)-3-(Benzylethylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3j): 217 mg, yield 83%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 11.26 (br s, 1 H), 7.25, 7.18 (m each, 2:2 H), 5.10 (s, 1 H), 3.47 (m, 2 H), 2.87 (m, 2 H), 2.31 (s, 3 H), 1.62 (m, 1 H), 0.96, 0.71 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 193.7, 166.7, 138.23, 128.6, 128.5, 126.5, 88.9, 45.5, 36.2, 19.9, 14.0, 8.6. HRMS (EI) calcd for $C_{15}H_{19}NOS$ $[M+H]^+$: 262.1266; Found: 262.1265.

(*E*)-3-(Vinylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3k): 310 mg, yield 78%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 11.16 (br s, 1 H), 5.77, 5.17, 5.07 (m, 1:1:1 H), 5.06 (s, 1 H), 3.83 (m, 2 H), 2.29 (s, 3 H), 1.57 (m, 1 H), 0.87, 0.63 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 193.7, 166.7, 133.0, 116.7, 89.2, 45.8, 19.9, 14.1, 8.6. HRMS (EI) calcd for $C_{10}H_{15}NOS$ $[M+H]^+$: 198.0953; Found: 198.0952.

(*E*)-3-(*iso*-Butylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3l): 149 mg, yield 70%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 11.14 (br s, 1 H), 4.94 (s, 1 H), 2.93 (t, 2 H), 2.20 (s, 3 H), 1.70 (m, 1 H) 1.47 (m, 1 H), 0.80 (d, J = 6.8

Hz, 3:3 H), 0.78, 0.53 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 193.0, 166.8, 88.3, 51.0, 28.4, 19.8, 19.6, 13.7, 8.2. HRMS (EI) calcd for $C_{11}H_{19}NOS$ $[M+H]^+$: 214.1266; Found: 214.1264.

(E)-1-Cyclopropyl-3-(cyclopropylamino)-3-(methylthio)prop-2-en-1-one (3m): 310 mg, yield 79%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.96 (br s, 1 H), 5.03 (s, 1 H), 2.50 (m, 1 H), 2.28 (s, 3 H), 1.56 (m, 1 H), 0.84, 0.61 (m each, 2:6 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 193.7, 169.2, 88.9, 24.9, 19.9, 14.1, 8.6, 7.9. HRMS (EI) calcd for $C_{10}H_{15}NOS$ $[M+H]^+$: 198.0953; Found: 198.0952.

(*E*)-3-(Cyclohexylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3n): 250 mg, yield 85%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.14 (br s, 1 H), 4.94 (s, 1 H), 3.36 (m, 1 H*CH*), 2.22 (s, 3 H), 1.78, 1.58, 1.53, 1.41, 1.15 (m each, 2:2:1:5 H), 1.46 (m, 1 H), 0.80, 0.55 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 192.9, 165.2, 88.2, 52.3, 32.9, 25.1, 24.1, 19.6, 13.8, 8.2. HRMS (EI) calcd for $C_{13}H_{21}NOS$ $[M+H]^+$: 240.1422; Found: 240.1422.

(*E*)-3-(Cycloheptylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3o): 210 mg, yield 83%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.21 (br s, 1 H), 4.95 (s, 1 H), 3.57 (m, 1 H), 2.25 (s, 3 H), 1.86 (m, 2 H), 1.54 (m, 11 H), 0.87, 0.56 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 192.8, 165.2, 88.2, 54.6, 35.1, 27.8, 23.7, 19.7, 13.9, 8.2. HRMS (EI) calcd for $C_{14}H_{23}NOS$ $[M+H]^+$: 254.1579; Found: 254.1579.

(*E*)-3-(Tetrahydrofuran-2-ylmethylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3p): 401 mg, yield 83%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.10 (br s, 1 H), 4.97 (s, 1 H), 3.88 (m, 1 H), 3.73 and 3.59 (m each, 1:1 H), 3.21 (m, 2 H), 2.22 (s, 3 H), 1.84 (m, 1 H), 1.73, 1.46 (m each, 2:2 H), 0.80, 0.54 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 193.7, 166.7, 89.2, 77.1, 68.3, 28.9, 25.6, 47.7, 19.9, 14.2, 8.6. HRMS (EI) calcd for $C_{12}H_{19}NO_2S$ $[M+H]^+$: 242.1215; Found: 242.1214.

(*E*)-Ethyl-2-((3-cyclopropyl-1-(methylthio)-3-oxoprop-1-en-1-yl)amino)acetate (3q): 140 mg, yield 63%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.31 (s, 1 H), 5.18 (s, 1 H), 4.19 (m, 2 H), 4.03 (m, 2 H), 2.37 (s, 3 H), 1.65 (m, 1 H), 1.24 (m, 3

H), 0.96, 0.70 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.8, 168.8, 165.9, 90.7, 61.6, 45.3, 20.3, 14.5, 14.2, 9.1. HRMS (EI) calcd for $C_{11}H_{17}NO_3S$ $[M+H]^+$: 244.1007; Found: 244.1005.

(*E*)-Methyl-2-((3-cyclopropyl-1-(methylthio)-3-oxoprop-1-en-1-yl)amino)-2-phenylacetate (3r): 198 mg, yield 65%, yellow solid, mp 108-109 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 11.97 (d, J = 7.5 Hz, 1 H), 7.40, 7.32 (m each, 2:3 H), 5.35 (d, J = 7.5 Hz, 1 H), 5.20 (s, 1 H), 3.70 (s, 3 H), 2.32 (s, 3 H), 1.69 (m, 1 H), 1.06, 0.73 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.9, 170.2, 164.8, 136.5, 129.0, 128.6, 127.2, 91.3, 60.8, 53.0, 20.4, 14.6, 9.2, 9.1. HRMS (EI) calcd for $C_{16}H_{19}NO_3S$ $[M+H]^+$: 306.1164; Found: 306.1166.

(*E*)-3-(Phenylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3s): 222 mg, yield 45%, yellow solid, mp 89-90 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 12.95 (br s, 1 H), 7.13, 7.01 (m each, 4:1 H), 5.24 (s, 1 H), 2.12 (s, 3 H), 1.70 (m, 1 H), 0.94, 0.72 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.1, 163.7, 137.7, 128.3, 125.1, 123.9, 91.2, 19.8, 13.8, 8.7. HRMS (EI) calcd for $C_{13}H_{15}NOS$ $[M+H]^+$: 234.0953; Found: 234.0954.

(*E*)-3-(*p*-Phenylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3t): 332 mg, yield 67%, white solid, mp 98-99 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 12.80 (br s, 1 H), 7.12, 7.06 (d each, J = 8.6 Hz, 2:2 H), 5.33 (s, 1 H), 2.30 (s, 6 H), 1.79, 1.08, 0.78 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 194.6, 165.0, 135.8, 135.5, 129.4, 125.0, 91.1, 20.9, 20.3, 14.4, 9.1. HRMS (EI) calcd for $C_{14}H_{17}NOS$ $[M+H]^+$: 248.1109; Found: 248.1109.

(*E*)-3-(1-Phenylethylamino)-3-(thiomethyl)-1-cyclopropylprop-2-en-1-one (3u): 159 mg, yield 61%, white solid, mp 68-70 °C, 99% ee, $[\alpha]^{20}_D$ = +668.21 (*c* 1.00, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 11.70 (br s, 1 H), 7.49–7.17 (m, 5 H), 5.17 (s, 1 H), 4.83 (m, 1 H), 2.31 (s, 3 H), 1.71 (m, 1 H), 1.57 (d, J = 6.8 Hz, 3 H), 1.05, 0.77 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 193.9, 166.3, 143.6, 128.6, 127.2, 125.8, 89.4, 53.8, 24.5, 20.1, 14.4, 8.8. HRMS (EI) calcd for $C_{15}H_{20}NOS$ $[M+H]^+$: 262.1266; Found: 262.1263. HPLC (AD-H column, *i*PrOH/hexane 3/97, 0.7 mL/min, 254 nm): t_1 = 9.4 min (major), t_2 = 10.2 min.

(*E*)-1-Cyclopropyl-3-((((2R,4aS,10aS)-7-isopropyl-2,4a,10a-trimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-2-yl)methyl)amino)-3-(methylthio)prop-2-en-1-one (3v): 320 mg, yield 73%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.49 (br s, 1 H), 7.19, 7.02 (d each, J = 8.1 Hz, 1:1 H), 6.92 (s, 1 H), 5.14 (s, 1 H), 3.23 (m, 2 H), 2.87 (m, 3 H), 2.40 (s, 3 H), 2.30 (d, J = 12.6 Hz, 1 H), 1.82, 1.68, 1.45, 1.00, 0.74 (m each, 2:3:4:2:2 H) 1.25, 1.24, 1.01 (6:3:3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 193.7, 167.4, 147.1, 145.6, 134.7, 126.9, 124.3, 123.9, 89.1, 55.9, 46.3, 38.2, 37.9, 37.6, 36.3, 33.5, 30.3, 26.9, 25.5, 24.1, 20.1, 19.4, 18.7, 18.2, 14.4, 8.8. HRMS (EI) calcd for $C_{27}H_{40}NOS$ $[M+H]^+$: 426.2831; Found: 426.2834.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-phenyl) cyclopropylprop-2-en-1-one (3w): 533 mg, yield 83%, white solid, mp 121-122 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.46 (br s, 1 H), 7.28, 7.11, 7.05 (m each, 7:2:1 H), 5.09 (s, 1 H), 4.43 (d, J = 6.0 Hz, 2 H), 2.40 (m, 1 H), 2.27 (s, 3 H), 1.85 (m, 1 H), 1.57, 1.17 (m each, 1:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.7, 167.4, 141.9, 137.4, 128.9, 128.4, 127.7, 127.4, 126.0, 125.9, 89.9, 47.8, 32.9, 26.9, 17.4, 14.4. HRMS (EI) calcd for $C_{20}H_{21}NOS$ $[M+H]^+$: 324.1422; Found: 324.1421.

(*E*)-3-(2-Bromobenzylamino)-3-(thiomethyl)-1-(2-phenyl)cyclopropylprop-2-en-1-one (3x): 302 mg, yield 75%, white solid, mp 131-132 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.63 (t, 1 H), 7.57 (d, J = 7.9 Hz, 1 H), 7.41, 7.34, 7.22 (m each, 1:3:4 H), 5.23 (s, 1 H), 4.62 (d, J = 6.3 Hz, 2 H), 2.56 (m, 1 H), 2.36 (s, 3 H), 2.03 (m, 1 H), 1.76, 1.30 (m each, 1:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.9, 167.4, 141.9, 136.6, 123.2, 132.9, 129.2, 128.9, 128.4, 127.8, 125.9, 90.4, 47.9, 32.9, 26.9, 17.5, 14.4. HRMS (EI) calcd for $C_{20}H_{20}B_rNOS$ $[M+H]^+$: 402.0527; Found: 402.0526.

(*E*)-3-(3-Bromobenzylamino)-3-(thiomethyl)-1-(2-phenyl)cyclopropylprop-2-en-1-one (3y): 716 mg, yield 89%, white solid, mp 130-131 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.60 (t, 1 H), 7.53, 7.33,(m each, 2:7 H), 5.23 (s, 1 H), 4.49 (d, J = 6.2 Hz, 2 H), 2.59 (m, 1 H), 2.36 (s, 3 H), 2.06 (m, 1 H), 1.71, 1.31 (m each, 1:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.8, 167.3, 141.7, 139.8, 122.8, 130.7, 130.3,130.2, 128.3, 128.2, 125.9, 90.3, 47.0, 32.8, 26.9, 17.5, 14.3. HRMS (EI) calcd for $C_{20}H_{20}B_rNOS$ $[M+H]^+$: 402.0527; Found: 402.0528.

(*E*)-3-(4-Bromobenzylamino)-3-(thiomethyl)-1-(2-phenyl)cyclopropylprop-2-en-1-one (3z): 699 mg, yield 87%, white solid, mp 129-130 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.59 (t, J = 5.6 Hz, 1 H), 7.48, 7.13 (d each, J = 8.4 Hz, 2:2 H) 7.29, 7.19 (m each, 2:3 H), 5.21 (s, 1 H), 4.47 (d, J = 6.1 Hz, 2 H), 2.57 (m, 1 H), 2.36 (s, 3 H), 1.96 (m, 1 H), 1.69, 1.29 (m each, 1:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.9, 167.3, 141.8, 136.5, 121.5, 131.9, 129.1, 128.4, 125.9, 90.2, 47.1, 32.8, 26.9, 17.5, 14.3. HRMS (EI) calcd for $C_{20}H_{20}B_rNOS$ $[M+H]^+$: 402.0527; Found: 402.0528.

(*E*)-3-(3-Methylbenzylamino)-3-(thiomethyl)-1-(2-phenyl)cyclopropylprop-2-en-1-one (3z1): 598 mg, yield 89%, white solid, mp 124-126 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.62 (br s, 1 H), 7.36-7.16 (m, 9 H), 5.27 (s, 1 H), 4.55 (d, J = 6.0 Hz, 2 H), 2.58 (m, 1 H), 2.42 (s, 3 H), 2.40 (s, 3 H), 2.00 (m, 1 H), 1.76, 1.35 (m each, 1:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.5, 167.3, 141.9, 138.4, 137.1, 128.6, 128.4, 128.3, 128.1, 125.9, 125.9, 124.4, 89.7, 47.7, 32.8, 26.7, 21.4, 17.3, 14.2. HRMS (EI) calcd for $C_{21}H_{23}NOS$ $[M+H]^+$: 338.1579; Found: 338.1574.

(*E*)-3-(4-Chlorobenzylamino)-3-(thiomethyl)-1-(2-phenyl) cyclopropylprop-2-en-1-one (3z2): 650 mg, yield 91%, white solid, mp 121-122 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.59 (br s, 1 H), 7.36, 7.28, 7.20, 7.17 (m each, 2:4:1:2 H), 5.22 (s, 1 H), 4.51 (d, J = 6.1 Hz, 2 H), 2.50 (m, 1 H), 2.39 (s, 3 H), 1.97, 1.72, 1.30 (m each, 1:1:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 192.0, 167.4, 141.9, 136.0, 133.5, 129.0, 128.8, 128.4, 126.1, 90.3, 47.1, 32.9, 27.0, 17.5, 14.4. HRMS (EI) calcd for $C_{20}H_{20}ClNOS$ $[M+H]^+$: 358.1032; Found: 358.1029.

(*E*)-3-(4-Trifluorbenzylamino)-3-(thiomethyl)-1-(2-phenyl) cyclopropylprop-2-en-1-one (3z3): 650 mg, yield 83%, white solid, mp 133-134 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.60 (br s, 1 H), 7.57, 7.39 (d each, J = 8.0 Hz, 2:2 H), 7.23 (d, J = 7.7 Hz, 2 H), 7.15, 7.08 (m each, 1:2 H), 5.18 (s, 1 H), 4.55 (d, J = 6.1 Hz, 2 H), 2.44 (m, 1 H), 2.33 (s, 3 H), 1.92 (m, 1 H), 1.62, 1.23 (m each, 1:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 192.3, 167.5, 141.9, 141.8 (q, J = 1.4 Hz), 129.9 (q, J = 32.5 Hz), 128.5, 127.6, 125.8 (q, J = 3.8 Hz), 124.2 (q, J = 272.0 Hz), 90.5, 47.3, 32.9, 27.2, 17.6, 14.4. HRMS (EI) calcd for $C_{21}H_{20}F_3NOS$ $[M+H]^+$: 392.1296; Found: 392.1292.

(*E*)-3-(Diphenylmethylamino)-3-(thiomethyl)-1-(2-phenyl)cyclopropylprop-2-

en-1-one (3z4): 573 mg, yield 71%, white solid, mp 129-130 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.18 (br s, 1 H), 7.43-7.29, 7.28-7.20 (m each, 12:3 H), 6.04 (s, 1 H), 5.29 (d, J = 7.9 Hz, 1 H), 2.63 (s, 1 H), 2.34 (s, 3 H), 2.06 (m, 1 H), 1.86, 1.38 (m each, 1:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.8, 166.5, 141.8, 141.5, 141.3, 128.8, 128.3, 127.6, 127.1, 125.9, 90.5, 62.1, 32.9, 26.9, 17.5, 14.5. HRMS (EI) calcd for $C_{26}H_{25}NOS$ $[M+H]^+$: 400.1735; Found: 400.1736.

(*E*)-3-(Cyclohexylamino)-3-(thiomethyl)-1-(2-phenyl) cyclopropylprop-2-en-1-one (3z5): 510 mg, yield 81%, white solid, mp 99-100 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.24 (br s, 1 H), 7.15, 7.05, 7.00 (m each, 2:1:2 H), 4.99 (s, 1 H), 3.43 (m, 1 H), 2.40 (m, 1 H), 2.23 (s, 3 H), 1.90 (m, 3 H), 1.62, 1.45, and 1.20 (m each, 3:1:6 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 190.8, 166.0, 142.0, 128.3, 125.8, 125.7, 88.9, 52.7, 33.2, 32.7, 26.5, 25.4, 24.4, 14.1, 17.1. HRMS (EI) calcd for $C_{19}H_{25}NOS$ $[M+H]^+$: 316.1735; Found: 316.1736.

(*E*)-3-(Cycloheptylamino)-3-(thiomethyl)-1-(2-phenyl)cyclopropylprop-2-en-1-one (3z6): 540 mg, yield 82%, white solid, mp 84-85 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.43 (br s, 1 H), 7.23, 7.13, 7.08 (d each, J = 7.3 Hz, 2:1:2 H), 3.72 (m, 1 H), 2.51 (m, 1 H), 2.30 (s, 3 H), 1.99, 1.69-1.58, 1.22 (m, 3:11:1 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 190.4, 165.6, 141.7, 128.0, 125.6, 88.6, 54.7, 35.0, 32.5, 27.9, 26.2, 23.7, 23.6, 16.9, 13.9. HRMS (EI) calcd for $C_{20}H_{27}NOS$ $[M+H]^+$: 330.1892; Found: 330.1891.

(*E*)-3-(2-Tertrahydrofurylmethylamino)-3-(thiomethyl)-1-(2-phenyl) cyclopropylprop-2-en-1-one (3z7): 512 mg, yield 81%, white solid, mp 109-110 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.34 (br s, 1 H), 7.23, 7.13, 7.10 (m each, 2:1:2 H), 5.12 (s, 1 H), 4.12, 3.94 (m, 1:1 H), 3.75 (m, 1 H), 3.48 (m, 2 H), 2.52, (m, 1 H), 2.31 (s, 3 H), 1.92-1.85, 1.66, 1.22 (m each, 4:2:1, 7 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 191.1, 167.0, 141.8, 128.1, 125.7, 125.6, 89.4, 76.8, 68.2, 47.6, 32.6, 28.8, 26.4, 25.6, 17.1, 13.9. HRMS (EI) calcd for $C_{18}H_{23}NO_2S$ $[M+H]^+$: 318.1528; Found: 318.1528.

(*E*)-3-(Benzylamino)-3-(thioethyl)-1-(2-phenyl) cyclopropylprop-2-en-1-one (3z8) 609 mg, yield 90%, white solid, mp 82-83 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.50 (t, 1 H), 7.22, 7.06 (m each, 7:3 H), 5.12 (s, 1 H), 4.37 (d, J = 5.9 Hz, 2 H), 2.79

(m, 2 H), 1.19 (t, J = 7.2 Hz, 3 H), 2.36 (m, 1 H), 1.80, 1.55, 1.12 (m each, 1:1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.4, 166.4, 141.8, 137.3, 128.7, 128.2, 127.5, 127.3, 125.8, 90.4, 47.7, 32.7, 26.7, 25.6, 17.3, 13.5. HRMS (EI) calcd for $C_{21}H_{23}NOS$ $[M+H]^+$: 338.1579; Found: 338.15745.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-(4-methyl) phenyl) cyclopropyl-prop-2-en-1-one (3z9): 490 mg, yield 73%, white solid, mp 79-80 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.58 (t, 1 H), 7.43, 7.11, 7.04 (m each, 5:2:2 H), 5.21 (s, 1 H), 4.54 (d, J = 6.0 Hz, 2 H), 2.55 (m, 1 H), 2.37 and 2.34 (s, 3:3 H), 1.99 (m, 1 H), 1.67 and 1.27 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.9, 167.3, 138.9, 137.4, 135.5 , 129.1, 128.8, 127.7, 127.42, 125.9, 89.9, 47.8, 32.8, 26.7, 21.1, 17.2, 14.4. HRMS (EI) calcd for $C_{21}H_{23}NOS$ $[M+H]^+$: 338.1579; Found: 338.1575.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-(4-methoxyl) phenyl) cyclopropyl-prop-2-en-1-one (3z10): 586 mg, yield 83%, white solid, mp 74-75 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.66 (t, 1 H), 7.43, 7.11, 6.88 (m each, 5:2:2 H), 5.26 (s, 1 H), 4.56 (d, J = 6.0 Hz, 2 H), 3.80 (s, 3 H), 2.62 (m, 1 H), 2.37 (s, 3 H), 2.03 (m, 1 H), 1.71, 1.28 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.6, 167.1, 157.8, 137.2, 133.6, 128.6, 127.4, 127.2, 126.9, 113.7, 89.7, 55.1, 47.6, 32.4, 26.1, 16.9, 14.1. HRMS (EI) calcd for $C_{21}H_{23}NO_2S$ $[M+H]^+$: 354.1528; Found: 354.1524.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-(4-bromo) phenyl) cyclopropylprop -2-en-1-one (3z11): 708 mg, yield 88%, white solid, mp 100-101 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.61 (br s, 1 H), 7.53, 6.98 (m each, 7:2 H), 5.21 (s, 1 H), 4.53 (d, J = 6.0 Hz, 2 H), 2.54 (m, 1 H), 2.35 (s, 3 H), 1.98 (m, 1 H), 1.75, 1.23 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 190.9, 167.5, 140.9, 137.1, 119.4, 131.2, 128.7, 127.6, 127.5, 127.3, 89.7, 47.7, 32.7, 26.0, 17.3, 14.2. HRMS (EI) calcd for $C_{20}H_{20}B_rNOS$ $[M+H]^+$: 402.0527; Found: 402.0523.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-(3-methyl) phenyl) cyclopropylprop -2-en-1-one (3z12): 561 mg, yield 83%, white solid, mp 71-72 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.71 (br s, 1 H), 7.55, 7.26, 7.10, 7.07 (m each, 5:1:1:2 H), 5.29 (s, 1 H), 4.60 (d, J = 6.0 Hz, 2 H), 2.58 (m, 1 H), 2.40 and 2.42 (s each, 3:3 H), 2.06 (m, 1 H), 1.79, 1.37 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.5, 167.2,

141.7, 137.7, 137.2, 128.6, 128.2, 127.5, 127.2, 126.6, 122.8, 89.8, 47.6, 32.7, 26.7, 21.3, 17.2, 14.1. HRMS (EI) calcd for $C_{21}H_{23}NOS$ $[M+H]^+$: 338.1579; Found: 338.1576.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-(3-trifluoromethyl) phenyl) cyclopropylprop-2-en-1-one (3z13): 400 mg, yield 84%, white solid, mp 110-111 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.63 (br s, 1 H), 7.45-7.27 (m, 9 H), 5.24 (s, 1 H), 4.54 (d, J = 6.0 Hz, 2 H), 2.57 (m, 1 H), 2.37 (s, 3 H), 2.00 (m, 1 H), 1.73 and 1.30 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 190.8, 167.8, 143.0, 137.2, 130.6 (q, J = 31.9 Hz), 128.8, 128.7, 127.7, 127.4, 124.2 (q, J = 272.4 Hz), 122.6, 89.8, 47.8, 32.8, 26.2, 17.5, 14.2. HRMS (EI) calcd for $C_{21}H_{20}F_3NOS$ $[M+H]^+$: 392.1296; Found: 392.1295.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-(1-fluoro) phenyl) cyclopropylprop-2-en-1-one (3z14): 560 mg, yield 82%, white solid, mp 86-87 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.65 (br s, 1 H), 7.41, 7.19, 7.09 (m each, 5:1:3 H), 5.24 (s, 1 H), 4.54 (d, J = 6.0 Hz, 2 H), 2.75 (m, 1 H), 2.36 (s, 3 H), 2.07 (m, 1 H), 1.74 and 1.35 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.2, 167.4, 161.5 (d, J = 246.0 Hz), 137.2, 128.9 (d, J = 13.9 Hz), 128.7, 127.5, 127.3, 127.1 (d, J = 8.0 Hz), 126.6 (d, J = 4.2 Hz), 123.8 (d, J = 3.6 Hz), 115.1 (d, J = 22.0 Hz), 89.7, 47.6, 30.9, 20.1 (d, J = 4.6 Hz), 15.9, 14.1. HRMS (EI) calcd for $C_{20}H_{20}FNOS$ $[M+H]^+$: 342.1328; Found: 342.1322.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-thiophenyl) cyclopropylprop-2-en-1-one (3z15): 560 mg, yield 85%, white solid, mp 90-91 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.57 (br s, 1 H), 7.37-7.30 (m, 5 H), 7.07, 6.98, 6.83 (m each, 1:1:1 H), 5.22 (s, 1 H), 4.54 (d, J = 5.9 Hz, 2 H), 2.87 (m, 1 H), 2.39 (s, 3 H), 2.07 (m, 1 H), 1.70, 1.27 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 190.9, 167.6, 146.4, 137.3, 128.8, 127.7, 127.4, 126.9, 123.3, 122.4, 89.9, 47.8, 33.4, 22.2, 18.4, 14.4. HRMS (EI) calcd for $C_{18}H_{19}NOS_2$ $[M+H]^+$: 330.0986; Found: 330.0984.

(*E*)-3-(4-Clorobenzylamino)-3-(thiomethyl)-1-(2-(4-bromo) phenyl) cyclopropylprop-2-en-1-one (3z16): 680 mg, yield 78%, white solid, mp 104-105 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.46 (br s, 1 H), 7.26, 7.20, 7.13, 6.86 (d each, J = 8.3,

8.4, and 8.8 Hz, 2:2:2:2 H), 5.08 (s, 1 H), 4.37 (d, J = 6.0 Hz, 2 H), 2.35 (m, 1 H), 2.25 (s, 3 H), 1.83 (m, 1 H), 1.55, 1.18 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.3, 167.5, 140.9, 135.8, 133.4, 119.5, 131.3, 128.9, 128.7, 127.7, 90.1, 47.0, 32.7, 26.2, 17.5, 14.3. HRMS (EI) calcd for $C_{20}H_{19}BrClNOS$ $[M+H]^+$: 436.0138; Found: 436.0137.

(*E*)-3-(Benzylamino)-3-(thiomethyl)-1-(2-phenylvinyl)cyclopropylprop-2-en-1-one (3z17): 424 mg, yield 61%, white solid, mp 94-96 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.58 (br s, 1 H), 7.39-7.19 (m, 10 H), 6.54 (d, J = 15.8 Hz, 1 H), 5.85 (dd, J = 15.7 and 8.9 Hz, 1 H), 5.22 (s, 1 H), 4.54 (d, J = 5.9 Hz, 2 H), 2.39 (s, 3 H), 2.27, 1.91 (m each, 1:1 H), 1.67, 1.05 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 191.6, 167.3, 137.4, 137.3, 132.0, 129.1, 128.8, 128.5, 127.6, 127.4, 126.9, 125.7, 89.9, 47.7, 30.3, 26.4, 16.5, 14.3. HRMS (EI) calcd for $C_{22}H_{23}NOS$ $[M+H]^+$: 350.1579; Found: 350.1580.

(*E*)-3-(Benzylamino)-1-(2-methyl-3-phenylcyclopropyl)-3-(methylthio)prop-2-en-1-one (3z18): 273 mg, yield 81%, white solid, mp 86-87 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.65 (br s, 1 H), 7.42, 7.20 (m each, 7:3 H), 5.28 (s, 1 H), 4.61 (m, 2 H), 2.60 (m, 1 H), 2.38 (s, 3 H), 2.16 (m, 1 H), 1.80 (m, 1 H), 1.43 (d, J = 6.2 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 190.9, 166.7, 142.3, 137.4, 128.7, 128.2, 127.4, 127.2, 125.9, 125.6, 91.3, 47.6, 37.8, 31.3, 27.1, 14.2, 11.8. HRMS (EI) calcd for $C_{21}H_{23}NOS$ $[M+H]^+$: 338.1579; Found: 338.1578.

(*E*)-3-(Benzylamino)-1-(2-(4-fluorophenyl)-3-methylcyclopropyl)-3-(methylthio)prop-2-en-1-one (3z19): 259 mg, yield 73%, white solid, mp 99-100 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 11.62 (br s, 1 H), 7.35, 7.08, 6.97 (m each, 5:2:2 H), 5.25 (s, 1 H), 4.52 (m, 2 H), 2.54 (t, 1 H), 2.36 (s, 3 H), 2.06, 1.67 (m each, 1:1 H), 1.37 (d, J = 6.2 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 190.7, 166.9, 161.1 (d, J = 243.5 Hz), 137.8 (d, J = 3.0 Hz), 137.4, 128.7, 127.4, 127.3, 115.0, 114.8, 91.2, 47.6, 37.5, 30.4, 26.9, 14.2, 11.7. HRMS (EI) calcd for $C_{21}H_{22}FNOS$ $[M+H]^+$: 356.11484; Found: 356.11485.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4a): 114 mg, yield 75%, white solid, mp 42-43 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ

7.37-7.26 (m, 6 H), 4.48 (d, J = 5.9 Hz, 2 H), 2.62 (m, 1 H), 2.25 (s, 3 H), 2.13 (s, 3 H), 0.88, 0.82 (m, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.6, 163.9, 160.0, 138.4, 128.8, 127.9, 127.6, 116.6, 43.8, 20.9 18.3, 14.2, 6.8. HRMS (EI) calcd for $C_{16}H_{19}NO_3S$ $[M+H]^+$: 306.1164; Found: 306.1165.

(*E*)-3-(*o*-Methylbenzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4b): 128 mg, yield 80%, white solid, mp 52-54 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.19-7.01 (m, 5 H NH), 4.37 (d, J = 5.5 Hz, 2 H), 2.52 (m, 1 H), 2.24 (s, 3 H), 2.15 (s, 3 H), 2.03 (s, 3 H), 0.78, 0.70 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.6, 160.1, 136.3, 135.8, 130.5, 128.4, 127.7, 126.2, 116.3, 41.8, 20.8 19.0, 18.2, 14.1, 6.8. HRMS (EI) calcd for $C_{17}H_{21}NO_3S$ $[M+H]^+$: 320.1320; Found: 320.1321.

(*E*)-3-(*m*-Methylbenzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4c): 115 mg, yield 72%, white solid, mp 54-55 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.27 (br s, 1 H), 7.20 (d, J = 7.2 Hz, 1 H), 7.08 (m, 3 H), 4.43 (d, J = 5.8 Hz, 2 H), 2.61 (m, 1 H), 2.33 (s, 3 H), 2.23 (s, 3 H), 2.12 (s, 3 H), 0.88, 0.80 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.7, 163.9, 160.1, 138.5 138.2, 128.7, 128.6, 128.3, 124.9, 116.5, 43.8, 21.5, 21.0, 18.3, 14.3, 6.9. HRMS (EI) calcd for $C_{17}H_{21}NO_3S$ $[M+H]^+$: 320.1320; Found: 320.1320.

(*E*)-3-(*p*-Methylbenzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4d): 112 mg, yield 70%, white solid, mp 52-53 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.25 (br s, 1 H), 7.13, 7.10 (d each, J = 7.9 Hz, 2:2 H), 4.38 (d, J = 5.8 Hz, 2 H), 2.56 (m, 1 H), 2.29 (s, 3 H), 2.19 (s, 3 H), 2.08 (s, 3 H), 0.84, 0.76 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.4, 163.6, 159.6, 136.9 135.1, 129.2 127.6, 116.4, 43.3, 20.9, 20.7, 14.0, 6.6. HRMS (EI) calcd for $C_{17}H_{21}NO_3S$ $[M+H]^+$: 320.1320; Found: 320.1318.

(*E*)-3-(*o*-Methoxylbenzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4e): 134 mg, yield 80%, white solid, mp 57-58 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.27 (br s, 1 H), 7.21 (t, J = 7.8 Hz, 1 H), 6.75 (m, 3 H), 4.42 (d, J = 5.9 Hz, 2 H), 3.77 (s, 3 H), 2.59 (m, 1 H), 2.22 (s, 3 H), 2.10 (s, 3 H), 0.85, 0.77 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.7, 160.0, 159.9 139.9, 129.7,

119.9, 113.2, 113.1, 116.4, 55.3, 43.7, 20.9, 18.2, 14.2, 6.8. HRMS (EI) calcd for $C_{17}H_{21}NO_4S$ $[M+H]^+$: 336.1270; Found: 336.1270.

(*E*)-3-(*o*-Flourbenzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4f): 120 mg, yield 74%, white solid, mp 83-84 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.33, 7.24, 7.07 (m each, 2:1:2 H NH), 4.51 (d, J = 6.0 Hz, 2 H), 2.59 (m, 1 H), 2.21 (s, 3 H), 2.11 (s, 3 H), 0.87, 0.83 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.6, 163.9, 162.3 160.1 (d, J = 246.2 Hz), 130.3 (d, J = 4.3 Hz), 129.4 (d, J = 8.1 Hz), 124.4 (d, J = 3.6 Hz), 115.4, 125.2 (d, J = 14.8 Hz, C_6H_4), 116.4, 37.7 (d, J = 4.0 Hz), 21.0, 18.2, 14.3, 6.9. HRMS (EI) calcd for $C_{16}H_{18}FNO_3S$ $[M+H]^+$: 324.1070; Found: 324.1075.

(*E*)-3-(*o*-Bromobenzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4g): 150 mg, yield 78%, white solid, mp 64-65 ^oC. ^1H NMR (400 MHz, $CDCl_3$) ^1H NMR (400 MHz, $CDCl_3$) δ 7.54 (d, J = 12.9, 1 H), 7.52 (br s, 1 H), 7.37 (d, J = 6.9 Hz), 7.27 (t, J = 7.2 Hz), 7.13 (m, 1:1:1 H), 4.53 (d, J = 6.1 Hz, 2 H), 2.62 (m, 1 H), 2.22 (s, 3 H), 2.11 (s, 3 H), 0.88, 0.84 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.4, 163.8, 160.3, 137.3 123.7, 132.8, 130.2, 129.2, 127.7 116.2, 43.9, 20.9, 18.2, 14.2, 6.8. HRMS (EI) calcd for $C_{16}H_{18}BrNO_3S$ $[M+H]^+$: 384.0269; Found: 384.0268.

(*E*)-3-(*m*-Bromobenzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4h): 144 mg, yield 75%, white solid, mp 67-68 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.41 (br s, 1 H), 7.37, 7.20, 7.17 (m, 2:1:1 H), 4.41 (d, J = 6.1 Hz, 2 H), 2.59 (m, 1 H), 2.22 (s, 3 H), 2.11 (s, 3 H), 0.86, 0.80 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 164.1, 160.5, 140.8 122.7, 130.6, 130.5, 130.3, 126.3, 116.14, 43.0, 20.9, 18.3, 14.2, 6.9. HRMS (EI) calcd for $C_{16}H_{18}BrNO_3S$ $[M+H]^+$: 384.0269; Found: 384.0265.

(*E*)-3-(*p*-Bromobenzylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4i): 140 mg, yield 73%, white solid, mp 66-68 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.42, 7.14 (d each, J = 8.0 Hz, 2:2 H), 7.36 (br s, 1 H), 4.39 (d, J = 6.0 Hz, 2 H), 2.60 (m, 1 H), 2.21 (s, 3 H), 2.10 (s, 3 H), 0.85, 0.79 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.9, 160.7, 137.5 121.3, 131.8 129.5, 116.0, 43.0,

21.0, 18.4, 14.3, 6.9. HRMS (EI) calcd for $C_{16}H_{19}BrNO_3S$ $[M+H]^+$: 384.0269; Found: 384.0265.

(*E*)-3-(Phenylethylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4j): yellow liquid. 126 mg, yield 79%, ^1H NMR (400 MHz, $CDCl_3$) δ 7.23, 7.14 (m each, 2:3 H), 7.02 (br s, 1 H), 3.46 (q, J = 6.6 Hz, 2 H), 2.76 (t, 2 H), 2.52 (m, 1 H), 2.08 (s, 3 H), 2.01 (s, 3 H), 0.80, 0.73 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.8, 160.2, 138.9, 128.8, 128.6, 126.5, 116.2, 40.8, 35.5, 21.0, 18.1, 14.2, 6.8. HRMS (EI) calcd for $C_{17}H_{21}NO_3S$ $[M+H]^+$: 320.1320; Found: 320.1323.

(*E*)-3-(Thienylmethylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4k): 101 mg, yield 79%, white solid, mp 42-43 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.11 (br s, 1 H), 5.85 (m, 1 H), 5.20 (dd, J = 17.2 and 1.5 Hz, 1 H), 5.14 (dd, J = 10.3 and 1.2 Hz, 1 H), 3.89 (m, 2 H), 2.61 (m, 1 H), 2.27 (s, 3 H), 2.16 (s, 3 H), 0.88, 0.82 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.6, 163.8, 160.4, 134.2, 116.4, 116.3, 42.2, 21.1, 18.4, 14.3, 6.9. HRMS (EI) calcd for $C_{12}H_{17}NO_3S$ $[M+H]^+$: 256.1007; Found: 256.1013.

(*E*)-3-(*iso*-Butylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4l): 119 mg, yield 88%, white solid, mp 54-55 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.03 (br s, 1 H), 3.04 (t, J = 6.4 Hz, 2 H), 2.54 (m, 1 H), 2.21 (s, 3 H), 2.10 (s, 3 H), 1.74 (m, 1 H), 0.87 (d, J = 6.7 Hz, 6 H), 0.80, 0.72 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.8, 159.4, 116.6, 47.0, 28.5, 21.0, 20.1, 18.2, 14.1, 6.6. HRMS (EI) calcd for $C_{13}H_{22}NO_3S$ $[M+H]^+$: 272.1320; Found: 272.1321.

(*E*)-1-Cyclopropyl-3-(cyclopropylamino)-2-(methylthio)-3-oxoprop-1-en-1-yl acetate (4m): 103 mg, yield 81%, white solid, mp 70-71 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.01 (br s, 1 H), 2.65 (m, 1 H), 2.51 (m, 1 H), 2.16 (s, 3 H), 2.11 (s, 3 H), 0.75, 0.42 (m each, 6:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.6, 165.5, 159.8, 116.2, 22.8, 21.1, 18.2, 14.2, 6.8. HRMS (EI) calcd for $C_{12}H_{17}NO_3S$ $[M+H]^+$: 256.1007; Found: 256.1007.

(*E*)-3-(Cyclohexylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4n):, 120 mg, yield 81%, white solid, mp 55-56 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 6.75 (br s, 1 H), 3.70 (m, 1 H), 2.47 (m, 1 H), 2.18 (s, 3 H), 2.08 (s, 3 H), 1.83, 1.63,

1.53, 1.31, 1.12 (m each, 2:2:1:2:3 H), 0.78, 0.70 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 162.8, 157.9, 117.2, 47.9, 32.9, 25.5, 24.7, 20.9, 17.8, 13.9, 6.5. HRMS (EI) calcd for $C_{15}H_{23}NO_3S$ $[M+H]^+$: 298.1477; Found: 298.1478.

(*E*)-3-(Cycloheptylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4o): 173 mg, yield 84%, white solid, mp 64-65 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.80 (br s, 1 H), 3.87 (m, 1 H), 2.45 (m, 1 H), 2.17 (s, 3 H), 2.07 (s, 3 H), 1.82, 1.60-1.38 (m each, 2:10 H), 0.76 0.69 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 162.5, 157.8, 117.2, 50.2, 34.9, 27.9, 23.9, 20.8, 17.7, 13.8, 6.4. HRMS (EI) calcd for $C_{16}H_{25}NO_3S$ $[M+H]^+$: 312.1633; Found: 312.1634.

(*E*)-3-(Tertrafurylmethylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4p): 97 mg, yield 65%, white solid, mp 52-53 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 (br s, 1 H), 3.95 (m, 1 H), 3.84, 3.72 (m each, 1:1 H), 3.52, 3.19 (m each, 1:1 H), 2.59 (m, 1 H), 2.24 (s, 3 H), 2.14 (s, 3 H), 1.90 (m, 4 H), 0.84, 0.77 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.9, 159.9, 116.6, 77.6, 68.2, 43.4, 28.6, 25.9, 21.0 18.3, 14.3, 6.8. HRMS (EI) calcd for $C_{14}H_{21}NO_4S$ $[M+H]^+$: 300.1270; Found: 300.1265.

(*E*)-Ethyl 2-(3-acetoxy-3-cyclopropyl-2-(methylthio)acrylamido)acetate (4q): 99 mg, yield 66%, colorless liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 (t, 1 H), 4.19 (m, 2 H), 4.03 (m, 2 H), 2.62 (m, 1 H), 2.31 (s, 3 H), 2.15 (s, 3 H), 1.26 (t, J = 7.2 Hz, 3 H), 0.88, 0.79 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 169.8 168.4, 163.9, 160.9, 115.9, 61.4, 41.5, 20.9, 18.2, 14.2, 14.1, 6.90. HRMS (EI) calcd for $C_{13}H_{19}NO_5S$ $[M+H]^+$: 302.1062; Found: 302.1063.

(*E*)-Methyl 2-(3-acetoxy-3-cyclopropyl-2-(methylthio)acrylamido)-2-phenyl acetate (4r): 123 mg, yield 68%, coluorless liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, J = 7.5 Hz, 1 H), 7.38-7.27 (m, 5 H), 5.54 (d, J = 7.5 Hz, 1 H), 3.67 (s, 3 H), 2.57 (m, 1 H), 2.26 (s, 3 H), 2.05 (s, 3 H), 0.84, 0.75 (m each, 2:2 H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 171.1 168.4, 163.2, 160.3, 136.2, 128.9, 128.5, 127.2, 116.1, 56.5, 52.6, 20.8, 17.9, 14.1, 6.8 6.7. HRMS (EI) calcd for $C_{18}H_{21}NO_5S$ $[M+H]^+$: 364.1219; Found: 364.1217.

***N*-Acetyl-3-cyclopropyl-2-(methylthio)-3-oxo-*N*-phenylpropanamide (4s′):** 90

mg, yield 62%, yellow solid, mp 101-102 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43, 7.18 (m each, 3:2 H), 5.29 (s, 1 H), 2.80 (m, 1 H), 2.03 (s, 6 H), 1.10, 0.96 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 200.7, 172.9, 169.6, 138.8, 129.8, 129.1, 128.8, 60.9, 26.3, 19.8, 13.8, 11.5 11.4. HRMS (EI) calcd for $C_{15}H_{17}NO_3S$ $[M+H]^+$: 292.1007; Found: 292.1007.

***N*-Acetyl-3-cyclopropyl-2-(methylthio)-3-oxo-*N*-(p-tolyl)propanamide (4t′):** 70 mg, yield 46%, yellow solid, mp 104-105 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.27, 7.08 (d each, J = 8.4 8.0 Hz, 2:2 H), 5.32 (s, 1 H), 2.40 (s, 3 H), 2.32 (m, 1 H), 2.11, 2.05 (s each, 3:3 H), 1.11, 1.01 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 200.8, 173.3, 169.8, 139.3 136.2, 130.6 128.6, 60.9, 26.4, 21.3 19.9, 13.8, 11.6, 11.5. HRMS (EI) calcd for $C_{16}H_{19}NO_3S$ $[M+H]^+$: 306.1164; Found: 306.1163.

(*E*)-3-(1-Phenylethylamino)-2-(thiomethyl)-3-oxo-1-cyclopropyl-1-enyl acetate (4u): 118 mg, yield 74%, white solid, mp 58-59 °C, 99% ee, $[\alpha]^{20}_D$ = 1.23 (*c* 1.00, $CHCl_3$). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35, 7.27 (m each, 4:1 H), 7.16 (d, J = 8.0 Hz, 1H), 5.15 (m, 1 H), 2.56 (m, 1 H), 2.23 (s, 3 H), 2.09 (s, 3 H), 1.52 (d, J = 6.9 Hz, 3 H), 0.88, 0.78 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.7, 163.1, 158.7, 143.1, 128.7, 127.4, 126.3, 117.0, 48.7, 21.9, 20.9, 17.9, 14.0, 6.7. HRMS (EI) calcd for $C_{17}H_{21}NO_3S$ $[M+H]^+$: 320.1320; Found: 320.1322. HPLC (OD-H column, *i*PrOH/hexane 30/70, 0.7 mL/min, 230 nm): t_1 = 8.8 min (major), t_2 = 23.7 min.

(*E*)-1-Cyclopropyl-3-((((1R,4aS,10aR)-7-isopropyl-1,4a-dimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthren-1-yl)methyl)amino)-2-(methylthio)-3-oxoprop-1-en-1-yl acetate (4v): 206 mg, yield 83%, colorless liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.17 (d, J = 8.2 Hz, 1 H), 7.13 (t, J = 6.3 Hz, 1 H), 6.99 (dd, J = 8.2 and 1.3 Hz, 1 H), 6.89 (s, 1 H), 3.21 (m, 2 H), 2.86, 2.60, 2.30 (m, 3:1:1 H), 2.21 (s, 3 H), 2.10 (s, 3 H), 1.92, 1.69, 1.45, 1.24, 0.97, 0.82 (m each, 1:2:4:9:3:5 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.2, 163.8, 159.5, 146.9, 145.4, 134.6, 116.6, 126.8, 124.1, 123.7, 50.3, 45.9, 38.3, 37.4, 37.5, 36.1, 33.4, 30.2, 26.8, 25.2, 23.9, 23.8, 20.8, 18.9, 18.5, 18.4, 18.2, 14.0, 6.6, 6.5. HRMS (EI) calcd for $C_{29}H_{42}NO_3S$ $[M+H]^+$: 484.2885; Found: 484.2880.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl-1-enyl

acetate (4w): 149 mg, yield 78%, white solid, mp 72-73 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32, 7.20, 7.13 (m each, 8:1:2 H), 4.48 (d, J = 5.9 Hz, 2 H), 2.84 (m, 1 H), 2.35 (m, 1 H), 2.20, 2.17 (s each, 3:3 H), 1.39 (m, 2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.6, 163.9, 158.5, 140.5 138.3, 128.8, 128.6, 127.9, 127.6, 126.4, 126.3, 117.1, 43.8, 26.1, 24.7, 21.1, 18.5, 15.4. HRMS (EI) calcd for $C_{22}H_{24}NO_3S$ $[M+H]^+$: 382.1477; Found: 382.1473.

(*E*)-3-(2-Bromobenzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl-1-enyl acetate (4x): 191 mg, yield 83%, white solid, mp 82-83 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 (d, J = 7.9 Hz, 1 H), 7.53 (t, 1 H), 7.41, 7.30, 7.27 (m each, 1:3:4 H), 4.57 (d, J = 6.1 Hz, 2 H), 2.87 (m, 1 H), 2.43 (m, 1 H), 2.21, 2.17 (s each, 3:3 H), 1.48 (m, 2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.5, 163.8, 158.7, 140.5, 137.3, 123.8, 132.8, 130.3, 129.2, 128.6, 127.8, 126.4, 126.3, 116.9, 44.1, 26.1, 24.7, 21.1, 18.5, 15.5. HRMS (EI) calcd for $C_{22}H_{22}BrNO_3S$ $[M+H]^+$: 460.0582; Found: 460.0577.

(*E*)-3-(3-Bromobenzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl -1-enyl acetate (4y): 173 mg, yield 75%, white solid, mp 80-81 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (s, 1 H), 7.39, 7.29, 7.24, 7.14 (m each, 2:2:3:2 H), 4.45 (d, J = 6.1 Hz, 2 H), 2.85, 2.35 (m each, 1:1 H), 2.21 2.17 (s each, 3:3 H), 1.48 (m, 2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.5, 164.0, 158.9, 140.7, 140.5, 122.8, 130.8, 130.7, 130.4, 128.6, 126.5, 126.4, 116.8, 43.1, 26.1 24.8, 21.1, 18.6, 15.4. HRMS (EI) calcd for $C_{22}H_{22}BrNO_3S$ $[M+H]^+$: 460.0582; Found: 460.0583.

(*E*)-3-(4-Bromobenzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl)cyclopropyl-1-enyl acetate (4z): 177 mg, yield 77%, white solid, mp 83-84 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45, 7.16 (d each, J = 8.4 Hz, 2:2 H), 7.37 (t, J = 5.8 Hz, 1 H), 7.29 (t, J = 7.4 Hz, 2 H), 7.21 (dt, J = 4.1 and 1.7 Hz, 1 H), 7.12 (m, 2 H), 4.42 (d, J = 6.0 Hz, 2 H), 2.84 2.37 (m each, 1:1 H), 2.20, 2.16 (s each, 3:3 H), 1.46 (m, 2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.5, 163.9, 159.1, 140.5, 137.4, 121.4, 116.7, 131.9, 129.5, 128.6, 126.5, 126.4, 43.1, 26.2, 24.8, 21.2, 18.6, 15.5. HRMS (EI) calcd for $C_{22}H_{22}BrNO_3S$ $[M+H]^+$: 460.0582; Found: 460.0580.

(*E*)-3-(3-Methylbenzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl

-1-enyl acetate (4z1): 142 mg, yield 72%, white solid, mp 70-71 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29, 7.25, 7.11 (m each, 3:2:5 H), 4.44 (d, J = 5.8 Hz, 2 H), 2.92, 2.34 (m each, 1:1 H), 2.36 (s, 3 H), 2.18, 2.16 (s each, 3:3 H), 1.46 (m, 2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.6, 163.9, 158.4, 140.6, 138.5, 138.2, 128.7, 128.6, 128.4, 126.5, 126.4, 124.9, 117.2, 43.9, 26.1, 24.7, 21.5, 21.1, 18.5, 15.4. HRMS (EI) calcd for $C_{23}H_{25}NO_3S$ $[M+H]^+$: 396.1633; Found: 396.1633.

(*E*)-3-(4-Chlorobenzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl -1-enyl acetate (4z2): 151 mg, yield 73%, white solid, mp 69-70 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 (br s, 1 H), 7.36, 7.28, 7.20 (m each, 4:3:2 H), 4.47 (d, J = 6.0 Hz, 2 H), 2.87, 2.37 (m each, 1:1 H), 2.22, 2.18 (s each, 3:3 H), 1.50 (m, 2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.5, 163.9, 158.9, 140.5, 136.9, 133.3, 116.7, 129.2, 128.9, 128.6, 126.5, 126.4, 43.1, 26.1, 24.8, 21.1, 18.6, 15.4. HRMS (EI) calcd for $C_{22}H_{22}ClNO_3S$ $[M+H]^+$: 416.1087; Found: 416.1084.

(*E*)-3-(4-Triflourobenzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl -1-enyl acetate (4z3): 162 mg, yield 72%, white solid, mp 87-88 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59, 7.40 (d each, J = 8.0 Hz, 2:2 H), 7.46 (br s, 1 H), 7.29, 7.20 (m each, 2:1 H), 7.13 (d, J = 7.3 Hz, 2 H), 4.54 (d, J = 6.1 Hz, 2 H), 2.86, 2.36 (m each, 1:1 H), 2.20, 2.18 (s each, 3:3 H), 1.45 (m, 2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.5, 164.1, 159.5, 142.5 (q, J = 2.6), 140.4, 129.8 (q, J = 32.3 Hz), 128.6, 127.9, 126.5, 126.4, 142.49, 125.7 (q, J = 3.8 Hz), 123.6 (q, J = 270.8 Hz), 116.5, 43.3, 26.2 24.9, 21.2, 18.7, 15.5. HRMS (EI) calcd for $C_{23}H_{23}F_3NO_3S$ $[M+H]^+$: 450.1351; Found: 450.1351.

(*E*)-3-(Dibenzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl-1-enyl acetate (4z4): 201 mg, yield 88%, white solid, mp 80-81 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (br s, 1 H), 7.42, 7.25, 7.19 (m each, 12:1:2 H), 6.34 (d, J = 8.6 Hz, 2 H), 2.88, 2.39 (m each, 1:1 H), 2.20, 2.14 (s each, 3:3 H), 1.52 (m, 2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.6, 163.0, 157.7, 141.5, 140.4, 117.4, 128.6, 128.5, 127.4, 127.3, 126.3, 126.2, 56.8, 25.9 24.6, 20.9, 18.2, 15.3. HRMS (EI) calcd for $C_{28}H_{27}NO_3S$ $[M+H]^+$: 458.1790; Found: 458.1792.

(*E*)-3-(Cyclohexylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl-1-enyl

acetate (4z5): 145 mg, yield 78%, white solid, mp 42-43 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30, 7.21, 7.17 (m each, 2:1:2 H), 6.83 (br s, 1 H), 3.87 (m, 1 H), 2.79, 2.33 (m each, 1:1 H), 2.22, 2.21 (s each, 3:3 H), 1.98, 1.70, 1.60, 1.40, 1.20 (m each, 2:2:1:4:3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.6, 162.8, 156.4, 140.6, 128.5, 126.4, 126.3, 117.9, 48.1, 33.1, 25.9, 25.6, 24.8, 24.4, 21.1, 18.1, 15.2. HRMS (EI) calcd for $C_{21}H_{27}NO_3S$ $[M+H]^+$: 374.1790; Found: 374.1789.

(*E*)-3-(Cycloheptylenzylamino)-2-(thiomethyl)-3-oxo-1-(2-phenyl) cyclopropyl -1-enyl acetate (4z6): 153 mg, yield 79%, white solid, mp 52-53 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30, 7.20, 7.12 (m each, 2:1:2 H), 6.90 (br s, 1 H), 3.98 (m, 1 H), 2.79, 2.33 (m each, 1:1 H), 2.25, 2.21 (s each, 3:3 H), 1.95 (m, 2 H), 1.60-1.36, 1.34 (m each, 10:2 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.7, 162.6, 156.5, 140.7, 128.6, 126.4, 126.3, 118.0 , 50.4, 35.2, 28.1, 25.8, 24.5, 24.1, 21.2, 18.1, 15.2. HRMS (EI) calcd for $C_{22}H_{29}NO_3S$ $[M+H]^+$: 388.1946; Found: 388.1947.

(*E*)-2-(Methylthio)-3-oxo-1-(2-phenylcyclopropyl)-3-(((tetrahydrofuran-2-yl)m ethyl)amino)prop-1-en-1-yl acetate (4z7): 129 mg, yield 69%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (t, J = 5.3 Hz, 1 H), 7.28, 7.18, 7.12 (m each, 2:1:2 H), 3.97, 3.85 (m each, 1:1 H), 3.73 (m, 1 H), 3.55, 3.21 (m each, 1:1 H), 2.84, 2.33, 1.91, 1.54, 1.37 (m, 3:1:2 H), 2.23, 2.19 (s each, 3:3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.5, 163.9, 158.4, 140.6, 128.6, 126.5 126.3, 117.3, 77.7, 68.3, 43.5, 28.7, 26.1, 26.0 24.7, 21.2, 21.2, 18.5, 15.4. HRMS (EI) calcd for $C_{20}H_{25}NO_4S$ $[M+H]^+$: 376.1583; Found: 376.1580.

(*E*)-3-(Benzylamino)-2-(thioethyl)-3-oxo-1-(2-phenyl) cyclopropyl-1-enyl acetate (4z8): 134 mg, yield 68%, white solid, mp 64-65 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30, 7.20, 7.10 (m each, 8:1:2 H), 4.47 (d, J = 5.8 Hz, 2 H), 2.91, 2.36 (m each, 1:1 H), 2.57 (m, 2 H, 2.23 (s, 3 H), 1.40 (m, 2 H), 1.19 (m, 3 H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 168.6, 164.2, 160.2, 140.5 138.3, 114.8, 128.8, 128.6, 127.9, 127.6, 126.4, 126.3, 43.9, 29.5, 26.4, 24.9, 21.2, 15.5, 14.6. HRMS (EI) calcd for $C_{23}H_{25}NO_3S$ $[M+H]^+$: 396.1633; Found: 396.1633.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-(2-(4-methylphenyl)) cyclopropyl-1-enyl acetate (4z9): 142 mg, yield 72%, yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$)

δ 7.41–7.26 (m, 6 H), 7.11, 7.04 (d each, J = 8.1 Hz, 2:2 H), 4.49 (d, J = 5.9 Hz, 2 H), 2.83, 2.33 (m, 1:1 H), 2.31, 2.27 (s each, 3:3 H), 2.10 (s, 3 H), 1.38 (m, 2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.8, 158.6, 138.2, 137.4, 135.9, 116.9, 129.2, 128.7, 127.7, 127.5, 126.2, 43.7, 25.9, 24.4, 21.0, 21.0, 18.4, 15.2. HRMS (EI) calcd for $C_{23}H_{25}NO_3S$ $[M+H]^+$: 396.1633; Found: 396.1637.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-(2-(4-methoxylphenyl)) cyclopropyl-1-enyl acetate (4z10): 171 mg, yield 83%, white solid, mp 72-73 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.55–7.26 (m, 6 H NH), 7.06 6.83 (d each, J = 8.7 Hz, 2:2 H), 4.48 (d, J = 5.9 Hz, 2 H), 3.78 (s, 3 H_3), 2.76, 2.30 (m each, 1:1 H), 2.20, 2.11 (s each, 3:3 H), 1.32 (m, 2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.6, 163.9, 158.8, 158.4, 138.3 132.5, 116.8, 128.8, 127.9, 127.6, 127.5, 114.1, 55.4, 43.8, 25.8, 24.2, 21.1, 18.6, 15.1. HRMS (EI) calcd for $C_{23}H_{25}NO_4S$ $[M+H]^+$: 412.1583; Found: 412.1584.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-(2-(4-bromophenyl)) cyclopropyl -1-enyl acetate (4z11): 168 mg, yield 73%, white solid, mp 75-76 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.29, 6.90 (d, J = 8.4 Hz, 2:2 H), 7.27-7.08 (m, 6 H), 4.38 (d, J = 5.9 Hz, 2 H), 2.69, 2.21 (m each, 1:1 H), 2.08, 2.06 (s each, 3:3 H), 1.32, 1.23 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.6, 157.6, 139.6, 138.1, 120.0 , 117.4, 131.5, 128.7, 127.9, 127.7, 127.5, 43.7, 26.1, 24.0, 20.9, 18.3, 15.2. HRMS (EI) calcd for $C_{22}H_{22}BrNO_3S$ $[M+H]^+$: 460.0582; Found: 460.0584.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-(2-(3-methylphenyl)) cyclopropyl-1-enyl acetate (4z12): 154 mg, yield 78%, yellow liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.36-7.27 (m, 6 H), 7.18, 7.02, 6.95 (m, 1:1:2 H), 4.48 (d, J = 5.9 Hz, 2 H), 2.82, 2.29 (m each, 1:1 H), 2.31 (s, 3 H), 2.18 (s, 3 H), 2.16 (s, 3 H), 1.40 (m, 2 H_2). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.6, 163.9, 158.6, 140.5, 138.3, 138.2, 117.0, 128.8, 128.5, 127.9, 127.6, 127.2, 127.1, 123.3, 43.9, 26.1, 24.7, 21.5, 21.1, 18.6, 15.4. HRMS (EI) calcd for $C_{23}H_{25}NO_3S$ $[M+H]^+$: 396.1633; Found: 396.1640.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-(2-(3-triflourophenyl)) cyclopropyl-1-enyl acetate (4z13): 173 mg, yield 77%, white solid, mp 68-69 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.50-7.27 (m, 10 H), 4.51 (d, J = 5.9 Hz, 2 H), 2.91, 2.41 (m each, 1:1 H), 2.22, 2.20 (s each, 3:3 H), 1.45 (m, 2 H). $^{13}C\{^1H\}$ NMR (100 MHz,

$CDCl_3$) δ 168.6, 163.7, 157.3, 141.6 138.2, 131.1 (q, J = 32.1 Hz), 129.7, 129.0, 127.7 (q, J = 3.9 Hz), 123.3 (q, J = 3.6 Hz), 128.8, 127.9, 127.6, 125.5 (q, J = 14.2 Hz), 117.8, 43.9, 26.1, 24.3, 21.1, 18.4, 15.3. HRMS (EI) calcd for $C_{23}H_{22}F_3NO_3S$ $[M+H]^+$: 450.1351; Found: 450.1352.

(*E*)-3-(Benzylamino)-2-(thiomethyl)-3-oxo-1-(2-(2-flourophenyl)) cyclopropyl -1-enyl acetate (4z14): 142 mg, yield 71%, white solid, mp 86-87 ^oC. ^1H NMR (400 MHz, $CDCl_3$) ^1H NMR (400 MHz, $CDCl_3$) δ 7.32, 7.20, 7.07 (m, 6:1:3 H), 4.51 (d, J = 5.9 Hz, 2 H), 2.91, 2.51 (m, 1:1 H), 2.22, 2.21 (s each, 3:3 H), 1.41 (m, 2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.7, 161.7 (d, J = 246.3 Hz), 157.8, 138.2, 128.7, 127.8, 127.5, 127.8 (d, J = 8.0 Hz), 127.5 (d, J = 14.2 Hz), 126.9 (d, J = 3.9 Hz). 124.1 (d, J = 3.6 Hz), (d, J = 21.9 Hz), 117.6, 43.8, 24.3, 20.9, 18.3 (d, J= 15.1 Hz), 18.2, 14.3. HRMS (EI) calcd for $C_{22}H_{22}FNO_3S$ $[M+H]^+$: 400.1383; Found: 400.1380.

(*E*)-3-(Benzylamino)-2-(methylthio)-3-oxo-1-(2-(thiophen-2-yl)cyclopropyl)pro p-1-en-1-yl acetate (4z15): 157 mg, yield 81%, white solid, mp 88-89 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.39-7.26 (m, 6 H), 7.10, 6.91, 6.83 (m each, 1:1:1 H), 4.48 (d, J = 5.9 Hz, 2 H), 2.88, 2.52 (m each, 1:1 H), 2.21, 2.18 (s each, 3:3 H), 1.44, 1.36 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.8, 157.7, 144.8, 138.2, 117.6, 128.9, 127.9, 127.6, 127.1, 123.9, 123.3, 43.9, 26.8, 21.1, 20.1, 18.6, 16.4. HRMS (EI) calcd for $C_{20}H_{21}NO_3S_2$ $[M+H]^+$: 388.1041; Found: 388.1043.

(*E*)-3-(4-Chlorobenzylamino)-2-(thiomethyl)-3-oxo-1-(2-(4-bromophenyl)) cyclopropyl-1-enyl acetate (4z16): 217 mg, yield 88%, white solid, mp 92-93 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 7.32, 7.23, 7.14, 6.92 (d each, J = 8.4 Hz, 2:2 H), 7.26 (t, 1 H), 4.36 (d, J = 6.0 Hz, 2 H), 2.72, 2.21 (m each, 1:1 H), 2.11, 2.10 (s each, 3:3 H), 1.34, 1.26 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.8, 158.3, 139.6, 136.8, 133.4, 120.2, 131.7, 129.2, 128.9, 128.1, 117.1, 43.7, 26.2, 24.2, 21.1, 18.5, 15.3. HRMS (EI) calcd for $C_{22}H_{21}BrClNO_3S$ $[M+H]^+$: 494.0192; Found: 494.0192.

(*E*)-3-(Benzylamino)-2-(methylthio)-3-oxo-1-(2-((*E*)-styryl)cyclopropyl)prop-1- en-1-yl acetate (4z17): 159 mg, yield 78%, white solid, mp 67-68 ^oC. ^1H NMR (400

MHz, $CDCl_3$) δ 7.32, 7.20 (m each, 10:1 H), 6.52 (d, J = 15.7 Hz, 1 H), 5.85 (dd, J = 15.7 8.6 Hz, 1 H), 4.49 (d, J = 5.9 Hz, 2 H), 2.75, 2.08 (m each, 1:1 H), 2.22, 2.18 (s each, 3:3 H), 1.32, 1.15 (m each, 1:1 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.4, 163.7, 158.3, 138.2 137.1, 130.6, 129.9, 128.7, 128.6, 127.8, 127.5, 127.2, 125.9, 116.9, 43.7, 24.2, 24.1, 21.0, 18.5, 14.7. HRMS (EI) calcd for $C_{24}H_{25}NO_3S$ $[M+H]^+$: 408.1633; Found: 408.1635.

***N*-Acetyl-3-cyclopropyl-2-(methylthio)-3-oxo-*N*-phenylpropanamide (4z18):** 138 mg, yield 70%, white solid, mp 72-73 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 7.31, 7.18, 7.13 (m each, 7:1:2 H), 7.06 (t, 1 H), 4.50 (m, 2 H), 2.61, 2.06, 1.72 (m each, 1:1:1 H), 2.22 (s, 3 H), 2.13 (s, 3 H), 1.27 (d, J = 6.3 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.5, 163.7, 154.3, 140.9, 138.2, 128.7, 128.4, 127.9, 127.6, 126.5, 126.2, 121.2, 43.7, 31.2, 30.7, 24.6, 20.9, 17.3, 13.9. HRMS (EI) calcd for $C_{23}H_{25}NO_3S$ $[M+H]^+$: 396.1633; Found: 396.1632.

***N*-Acetyl-3-cyclopropyl-2-(methylthio)-3-oxo-*N*-phenylpropanamide (4z19):** 140 mg, yield 68%, white solid, mp 113-114 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 7.35, 7.11, 6.99 (m each, 5:2:3 H), 4.51 (m, 2 H), 2.55, 2.03, 1.68 (m each, 1:1:1 H), 2.23 (s, 3 H), 2.14 (s, 3 H), 1.27 (d, J = 6.3 Hz, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 168.6, 163.6, 161.5 (d, J = 244.2 Hz), 154.2, 138.2, 136.5 (d, J = 3.1 Hz), 128.8, 127.9, 127.6, 128.2 (d, J = 7.9 Hz), 115.2 (d, J = 21.4 Hz), 121.4, 43.8, 30.6, 30.5, 24.5, 20.9, 17.4, 13.9. HRMS (EI) calcd for $C_{23}H_{24}FNO_3S$ $[M+H]^+$: 414.1539; Found: 414.1534.

(*E*)-3-(Benzylamino)-1-cyclopropyl-2-(methylthio)-3-oxoprop-1-en-1-yl pivalate (4z20): 113 mg, yield 65%, colorless liquid. ^1H NMR (400 MHz, $CDCl_3$) δ 7.30 (m, 5 H), 6.98 (br s, 1 H), 4.45 (d, J = 5.8 Hz, 2 H), 2.54 (m, 1 H), 2.23 (s, 3 H), 1.23 (s, 9 H), 0.85, 0.72 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 175.9, 164.2, 157.4, 138.4, 128.8, 127.9, 127.5, 117.6, 43.8, 39.4, 27.2, 17.9, 14.0, 6.6. HRMS (EI) calcd for $C_{19}H_{25}NO_3S$ $[M+H]^+$: 348.1633; Found: 348.1631.

(*E*)-3-(Benzylamino)-1-cyclopropyl-2-(methylthio)-3-oxoprop-1-en-1-yl benzoate (4z21): 145 mg, yield 79%, yellow solid, mp 72-73 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 8.12, 7.58, 7.44, 7.20 (m each, 2:1:2:5 H), 7.12 (br s, 1 H), 4.39 (d, J = 5.9

Hz, 2 H), 2.64 (m, 1 H), 2.29 (s, 3 H), 0.84, 0.74 (m each, 2:2 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 164.3, 163.9, 157.8, 138.1 133.7 130.2, 128.9, 128.6, 128.5, 127.7, 127.4, 117.9, 43.7, 17.9, 14.2, 6.8. HRMS (EI) calcd for $C_{21}H_{21}NO_3S$ $[M+H]^+$: 368.1320; Found: 368.1321.

(*E*)-3-(Benzylamino)-1-cyclopropyl-2-(methylthio)-3-oxoprop-1-en-1-yl 2-iodo benzoate (4z22): 182 mg, yield 74%, yellow solid, mp 76-77 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 8.02, 7.42, 7.23 (m each, 2:1:7 H), 4.44 (m, 2 H), 2.66 (m, 1 H), 2.30 (s, 3 H), 0.92 (m, 4 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 163.9, 163.5, 158.1, 138.0, 132.2, 94.9, 141.4, 133.3, 128.6, 128.1, 127.7, 127.4, 117.7, 43.7, 17.9, 14.1, 6.9. HRMS (EI) calcd for $C_{21}H_{20}NO_3SI$ $[M+H]^+$: 494.0287; Found: 494.0288.

(2*E*,4*E*)-*N*-Benzyl-3-hydroxy-5-(4-methoxyphenyl)-2-(thiomethyl)penta-2,4-die namide (8a): 79 mg, yield 74%, yellow solid, mp 95-98 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 15.28 (s, 1 H), 7.70, 7.53, 7.33 (m each, 1:4:5 H), 6.92 (d, J = 8.7 Hz, 2 H), 4.56 (d, J = 6.0 Hz, 2 H), 3.84 (s, 3 H), 2.15 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 173.3, 172.3, 160.9, 138.1, 128.7 , 138.4, 129.6, 128.9, 127.7, 114.4, 127.6 117.9, 96.5, 55.5, 43.7, 20.8. HRMS (EI) calcd for $C_{20}H_{22}NO_3S$ $[M+H]^+$: 356.1320; Found: 356.1314.

(2*E*,4*E*)-*N*-Benzyl-3-hydroxy-2-(thiomethyl)-5-(thiophen-2-yl)penta-2,4-diena mide (8b): 71 mg, yield 71%, yellow solid, mp 105-107 ^oC. ^1H NMR (400 MHz, $CDCl_3$) δ 15.22 (s, 1 H), 7.69 (br s, 1 H), 7.65, 7.45 (d each, J = 15.6 Hz, 1:1 H), 7.46-7.23 (m, 6 H, 1 H), 7.24 (d, J = 3.5 Hz, 1 H), 7.05 (m, 1 H), 4.56 (d, J = 5.9 Hz, 2 H), 2.15 (s, 3 H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 172.5, 172.1, 141.5 138.1, 131.4, 129.8, 128.9, 127.7, 127.6, 127.5, 128.2, 119.4, 97.1, 43.7, 20.9. HRMS (EI) calcd for $C_{17}H_{18}NO_2S_2$ $[M+H]^+$: 332.0779; Found: 332.0774.

ASSOCIATED CONTENTS

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Notes

The authors declare no competing financial interest.

Supporting Information Available

NMR spectra of the substrates and products, HPLC spectra for racemic and chiral products, and X-ray crystallographic analysis for compounds **2h**, **2o′**, **2p′′**, **4f**, and **4s′**. This material is available free of charge via the Internet at http://pubs.acs.org.

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