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Potassium Hydroxide-Catalyzed Chemoselective Reduction of Cyclic Imides with Hydrosilanes: Synthesis of ω-Hydroxylactams and Lactams

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Abstract: Potassium hydroxide-catalyzed hydrosilylation exhibits excellent activity and chemoselectivity for the reduction of cyclic imides under mild reaction conditions. The chemoselectivity of the reduction system may be readily tuned by changing the identity and stoichiometry of the hydrosilanes: a polymethylhydrosiloxane (PMHS)/potassium hydroxide reduction system resulted in the reduction of various cyclic imides to the corresponding ω-hydroxylactams in 70–94% yield, while the diphenylsilane (Ph_2SiH_2)/potassium hydroxide reduction system selectively afforded the aryl lactams in 33–95% yield. These catalytic protocols tolerate diverse functional groups and are easy to scale up.

Keywords: base catalysis; cyclic imides; hydrosilylation; ω-hydroxylactams; lactams

Introduction

The reduction of carbonyl groups is an important transformation in organic synthesis, and the chemoselective reduction of multi-functionalized carbonyl compounds under mild conditions is challenging.[1] The reduction of cyclic imides gives several nitrogen-containing products, such as ω-hydroxylactams,[2] lactams,[3] substituted pyrroles,[4] pyrrolidines[5] and 4-hydroxybutyric amides (ring-opening products).[6] Most of these compounds are important structure motifs in natural products and pharmaceuticals and are versatile building blocks for organic synthesis.[4f,7] The highly chemoselective reduction of cyclic imides would provide an efficient and straightforward access to these nitrogen-containing products. Typical reduction conditions using $LiAlH_4$ or $NaBH_4$ require harsh conditions and laborious set-ups (i.e., anhydrous conditions and low reaction temperatures), and the reduction reactions were accompanied with over-reduction by-products.[1,8] For example, 4-hydroxybutyric amides (ring-opening products) were always formed as by-products in the synthesis of ω-hydroxylactams,[9] and pyrrolidines were obtained with pyrroles as by-products.[4a,10] Therefore, it is an important synthetic challenge to develop a mild and highly selective reduction method to access the cyclic compounds.

The use of organosilicon hydrides is an appealing methodology for the selective reduction. In contrast to metal hydride reducing agents, hydrosilanes are mild air- and water-stable sources of hydride and can be activated under mild conditions.[11] Furthermore, the chemo- and regioselectivity of the reduction with silanes can be easily tuned by changing the substituents on the silicon atom of the hydrosilanes and the employed catalysts.[12]

The metal/Lewis acid-catalyzed hydrosilylation of carbonyl compounds has been well-explored and a series of the highly chemo-, regio-, and/or stereoselective reduction methods of ketones,[13] esters,[14] amides,[15]and CO_2[15k,16] have been developed. Beside these, Lewis base-catalyzed hydrosilylation of carbonyl compounds has also drawn much attention, due to the more environmentally benign and mild conditions.[17] Fluoride ion used as a Lewis base catalyst displayed high efficiency in the hydrosilylation of

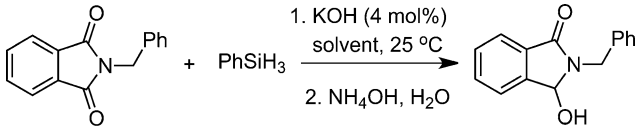
ketones and hydroxy esters.[17a,b,e] The reduction of α-keto amides with hydrosilanes catalyzed by tetrabutylammonium flouride (TBAF) selectively afforded α-hydroxy amides or β-amino alcohols by tuning the hydrosilanes and the stoichiometry of the active hydride.[18] Moreover, lithium methoxide was also used as a catalyst in the reduction of epoxy ketones and hydroxy esters with hydrosilanes.[17l,m] Lately, base (KOH,[17f,g,i] Cs_2CO_3[17h] or *t*-BuOK[17j]) catalyzed reductions of non-functionalized esters or amides with hydrosilanes were realized.

There are a few literature examples that explore the chemoselective reduction of imides with hydrosilanes. *N*-Benzylsuccinimide was reduced with Ph_2SiH_2 catalyzed by $RhH(CO)(PPh_3)_3$ to give the corresponding pyrrolidine,[15a] the fluoride-catalyzed hydrosilylation of aryl imides with polymethylhydrosiloxane (PMHS) afforded the lactams,[19] and recently we developed a zinc-catalyzed selective hydrosilylation of imides to access ω-hydroxylactams.[20] However, controlling the chemoselective reduction of cyclic imides by choosing the appropriate hydrosilane and/or catalyst has not been reported. Herein, we report a base-catalyzed reduction of cyclic imides with hydrosilanes which focused on tuning the chemoselectivity of the reduction system by changing the identity and stoichiometry of the hydrosilanes.

Results and Discussion

The reduction of *N*-benzylphthalimide (**1a**) was chosen as the model reaction to explore the chemoselectivity of the base-catalyzed reduction of cyclic imides with hydrosilanes. Our initial effort was focused on developing a catalytic system for selective reduction of cyclic imides (**1**) to afford ω-hydroxylactams (**2**) which serve as important precursors of *N*-acyliminium ions.[21] We tested the reduction of *N*-benzylphthalimide (**1a**) with $PhSiH_3$ and KOH as a catalyst at room temperature based on the hydrosilylation of amides.[17g] Without solvent, the reaction selectively gave ω-hydroxylactam (**2a**), but only 14% of *N*-benzylphthalimide (**1a**) was consumed after 12 h (Table 1, entry 1). To enhance the homogeneity of reaction system, a series of solvents were explored. No conversion occurred at room temperature in nonpolar solvents such as hexane and cyclohexane (Table 1, entries 2 and 3), while the reduction afforded selectively the target product (**2a**) in 80% yield in toluene (entry 4), in which better solubility of the imide (**1a**) was achieved. The use of ethereal solvent did not improve the conversion significantly (Table 1, entries 5 and 6). The reduction was then tested in more polar solvents. The imide (**1a**) was converted completely in HMPA (hexamethylphosphoramide) after 3 h at room temperature to form selectively **2a**

Table 1. The solvent effect on the base-catalyzed selective reduction of cyclic imides (**1a**) to ω-hydroxylactams (**2a**) with $PhSiH_3$[a]



1a **2a**

Entry	Solvent	Time	Conversion[b]	Yield[b]
1	no solvent	12 h	14%	14%
2	hexane	12 h	–	–
3	cyclohexane	12 h	–	–
4	toluene	12 h	80%	80%
5	THF	12 h	45%	45%
6	dioxane	12 h	85%	85%
7	HMPA	3 h	>97%	>97%
8	DMF	3 h	>97%	>97%
9	DMA	3 h	>97%	>97%
10	NMP	12 h	50%	45%

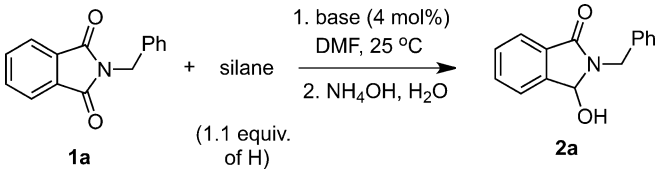
[a] *Reaction conditions:* *N*-benzylphthalimide (**1a**, 3 mmol), $PhSiH_3$ (1.1 equiv. of H, 1.1 mmol), KOH (4 mol%), solvent (3 mL), 25 °C.

[b] Conversion and yields were determined by ^{1}H NMR analysis (internal standard: 4,4′-di-*tert*-butyl-1,1′-biphenyl).

without over-reduced or hydrolyzed compounds (Table 1, entry 7). This may be ascribed to the fact that HMPA can serve as a silaphilic nucleophile to form the hexacoordinated silicate $[HSiR_3F(HMPA)]$ as the active hydride species, which accelerated the TBAF-catalyzed reduction of aldehydes and ketones with hydrosilanes.[17e,22] High activity and chemoselectivity were still observed when DMF or DMA was used as the solvent (Table 1, entries 8 and 9). Using NMP (*N*-methylpyrrolidin-2-one) as the solvent led to a decrease in the conversion (Table 1, entry 10). Consequently, DMF was chosen as the solvent for the following exploration.

The effect of bases and hydrosilanes on the reduction of cyclic imides was then explored. A number of inorganic bases were tested in the reduction of *N*-benzylphthalimide (**1a**) with $PhSiH_3$ and excellent chemoselectivity and yields were achieved (Table 2, entries 1–8). Hydroxide and alkoxide displayed good catalytic activity to afford an almost quantitative yield of ω-hydroxylactam (**2a**) within 4 h at room temperature (Table 2, entries 1–4), while using the weaker bases required longer reaction time (Table 2, entries 5–8). Omission of the base or hydrosilane resulted in no desired reduction of the imide (**1a**) (Table 2, entries 9 and 10). The conversion of **1a** was decreased when $PhSiH_3$ was replaced with $(EtO)_3SiH$ (Table 2, entries 11 and 12). Gratifyingly, other accessible hydrosilanes were efficient for this reductive system and excellent selectivity and activity were also obtained

Table 2. The effect of bases and silanes on the base-catalyzed selective reduction of cyclic imides (**1a**) to ω-hydroxylactams (**2a**).[a]



1a 2a

Entry	Silane	Base	Time	Yield[b]
1	$PhSiH_3$	KOH	3 h	>97%
2	$PhSiH_3$	NaOH	4 h	85%
3	$PhSiH_3$	*t*-BuOK	4 h	>97%
4	$PhSiH_3$	*t*-BuONa	4 h	>97%
5	$PhSiH_3$	Cs_2CO_3	22 h	>97%
6	$PhSiH_3$	K_2CO_3	22 h	>97%
7	$PhSiH_3$	K_3PO_4	22 h	>97%
8	$PhSiH_3$	Na_2CO_3	22 h	>97%
9	$PhSiH_3$	–	22 h	–
10	–	KOH	22 h	–
11	$(EtO)_3SiH$	KOH	22 h	85%
12	$(EtO)_3SiH$	Na_2CO_3	22 h	45%
13	Ph_2SiH_2	KOH	3 h	>97%
14	Ph_2SiH_2	Na_2CO_3	22 h	>97%
15	PMHS	KOH	6 h	>97%
16	PMHS	Na_2CO_3	22 h	84%
17	PMHS	KOH (10 mmol%)	3 h	>97%
18	PMHS	KOH (2.5 mmol%)	6 h	>97%
19	PMHS	KOH (1.0 mmol%)	22 h	>97%

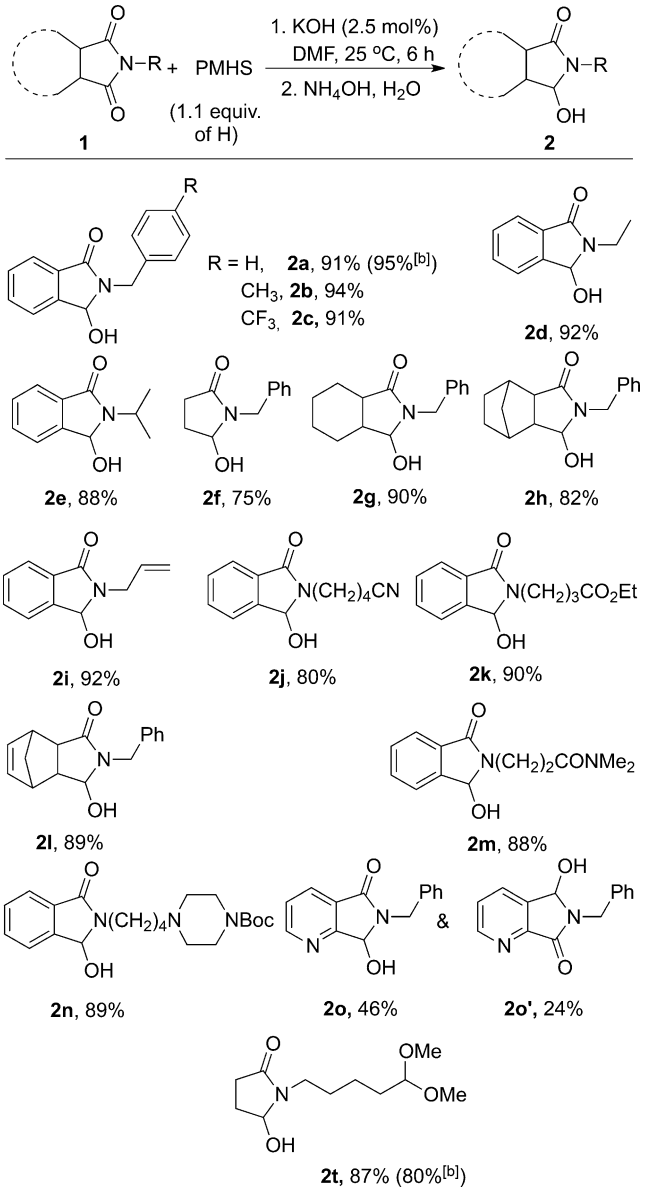
[a] *Reaction conditions: N*-benzylphthalimide (**1a**, 3 mmol), silanes (1.1 equiv. of H), base (4 mol%), DMF (3 mL), 25 °C.

[b] Yields were determined by ^{1}H NMR analysis (internal standard: 4,4′-di-*tert*-butyl-1,1′-biphenyl).

(Table 2, entries 13–16). Especially noteworthy is the use of PMHS, a safe and inexpensive silane, which afforded the ω-hydroxylactam (**2a**) in quantitative yield after 6 h. Furthermore, increasing the loading of KOH shortened the reaction time, and no hydrolyzed compounds were observed. A quantitative yield of **2a** was obtained in 6 h even when the KOH loading was lowered to 2.5 mol%.

The scope of the base-catalyzed chemoselective reduction of the cyclic imides (**1**) to ω-hydroxylactams (**2**) was probed under the optimized conditions. As shown in Table 3, the reduction reactions led to efficient formation of a number of ω-hydroxylactams (**2**) at room temperature. The electronic nature and steric hindrance of the substituents at the nitrogen atom did not affect the selective reduction to ω-hydroxylactams (**2**). Both *N*-(4-methyl)benzylphthalimide (**1b**) and *N*-(4-trifluoromethyl)benzylphthalimide (**1c**) were reduced chemoselectively in excellent yields. The reduction of bulkier *N*-isopropylphthalimide also afforded the corresponding product (**2e**) in 88% yield. High reactivity and selectivity were observed with aromatic,

Table 3. The selective reduction of cyclic imides (**1**) to ω-hydroxylactams (**2**) with hydrosilanes.[a]



[a] *Reaction conditions:* imide (**1**, 3.0 mmol), PMHS (1.1 equiv. of H, 200 mg), KOH (2.5 mol%), DMF (3 mL), 25 °C, isolated yield.

[b] The reduction was conducted on a 5.0 g scale.

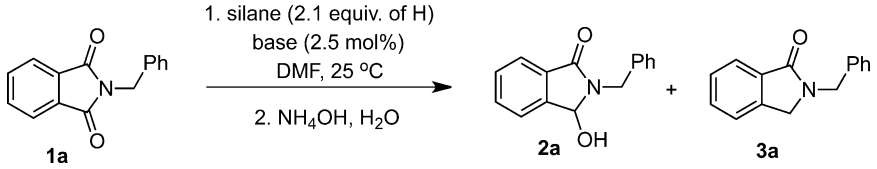
aliphatic and polycyclic substrates. The polycyclic aliphatic ω-hydroxylactams (**2g**) and (**2h**) were generated in 90% and 82% yield, respectively. Furthermore, the reduction system tolerates diverse functional groups, including alkene, nitrile, ester, amide, carbamic ester, and aromatic heterocycle. This broad functional group tolerance contrasts with the reactivity observed with typical metal hydride reagents in which functional groups such as esters and nitriles are not tolerated. Notable examples include the reduction of a phthalimide with a pendant ethyl ester (**1k**) and

a Boc-protected amine (**1n**). It is interesting that the reduction of *N*-benzyl-2,3-pyridinedicarboximide (**1o**) proceeded smoothly with good chemoselectivity, and displayed a modest regioselective reduction at the carbonyl adjacent to the nitrogen atom of pyridine in a 2:1 ratio with 70% overall yield of the ω-hydroxylactams. The scaled-up reduction ran effectively and a 5 g scale reduction of *N*-benzylphthalimide (**1a**) with PMHS afforded a 90% isolated yield of **2a**. We can also easily scale-up the reduction to access 1-(5,5-dimethoxypentyl)-5-hydroxypyrrolidin-2-one (**2t**), an important intermediate of bioactive Tashiromine, in 80% yield.[23]

Following the realization of the base-catalyzed selective reduction of cyclic imides to ω-hydroxylactams, we then explored reaction conditions for selective reduction of cyclic imides (**1**) to afford lactams (**3**) (Table 4). Increasing the equivalent of PMHS to provide 2.1 equivalents of hydride resulted in 25% lactam (**3a**) and 75% ω-hydroxylactam (**2a**) (Table 4, entry 2). Increasing the hydride equivalents to 6.0 and prolonging the reaction time increased the yield of lactam (**3a**) to 79%, while 18% of ω-hydroxylactam (**2a**) remained (Table 4, entry 3). Elevated temperatures did not improve the outcome significantly (Table 4, entry 4). Using more reactive silanes, $PhSiH_3$ or Ph_2SiH_2 (2.1 equiv. of H) resulted in quantitative yield of lactam (**3a**) within 3 h. In addition, the effect of bases on the selective reduction to afford lactams (**3**) was investigated with Ph_2SiH_2. The intermediate (**2a**) could not be converted completely to the product with either a stronger base (*t*-BuOK), or a weaker base (NaOH or K_3PO_4) as catalyst. The substrate scope for the reduction of imides to lactams was explored with the Ph_2SiH_2/KOH system due to the commercial availability and lower cost of Ph_2SiH_2 than that of $PhSiH_3$.

The scope of base-catalyzed chemoselective reduction of cyclic imides (**1**) to lactams (**3**) was further examined (Table 5). Aromatic cyclic imides (**1**) were reduced smoothly to the corresponding lactams (**3**) in excellent yield under optimized reduction conditions. The reduction reaction afforded *N*-benzyllactam (**3a**) in 90% yield. Lactam (**3b**) with an electron-donating group at the nitrogen atom also was obtained in 89% yield. However, electron-withdrawing groups at the nitrogen atom inhibited the reaction and the yield of the corresponding lactam (**3c**) decreased to 52% and 47% of the intermediate, ω-hydroxylactam derivative, was observed. The steric profile of the carbonyl group did not appear to affect the reduction of 2-methyl-4-propylisoindoline-1,3-dione (**1s**), giving a mixture of the two possible lactams (**3s** and **3s′**) in a 1:1 ratio. The reduction system tolerated several functional groups, such as alkene (**3i**), nitrile (**3j**), ester (**3k**), amide (**3m**), carbamic ester (**3n**) and aromatic heterocycles (**3o** and **3o′**). The aromatic heterocyclic lactam (**3r**) was obtained in 42% yield. In the cases of the reduction of the imides (**3p**, **3k** and **3q**) with the ester group on the substituent chain at the nitrogen atom, the corresponding lactams were generated in moderate yield because of incomplete conversion of the ω-hydroxylactam derivative. In addition, the reduction was easily scaled up to a 5.0 g scale reaction, and KOH-catalyzed reduction of *N*-benzylphthalimide (**1a**) with Ph_2SiH_2 (1.1 equiv.) afforded the lactam (**3a**) with 92% isolated yield. Unfortunately, the reduction of aliphatic cyclic imides to the corresponding lactams was not successful under these conditions.

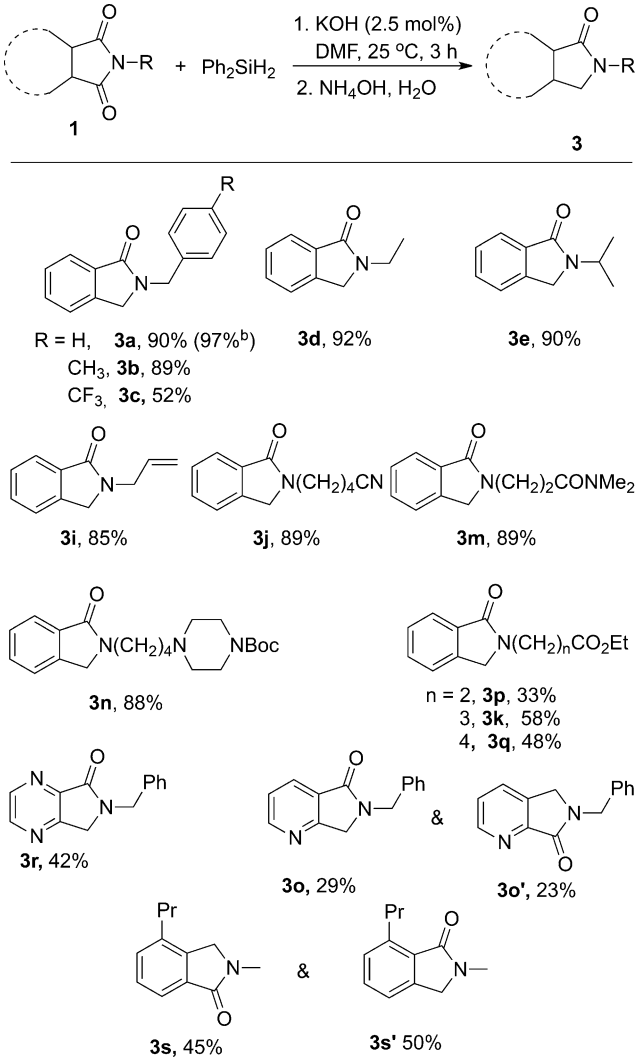
Table 4. The effect of silanes and bases on the selective reduction of cyclic imides (**1a**) to lactams (**3a**) with hydrosilanes.[a]



Entry	Silane	Base	Time	Yield[b]	
				2a	**3a**
1	PMHS (1.1 equiv. H)	KOH	6 h	>97%	–
2	PMHS (2.1 equiv. H)	KOH	6 h	72%	25%
3	PMHS (6.0 equiv. H)	KOH	22 h	18%	79%
4[c]	PMHS (6.0 equiv. H)	KOH	22 h	10%	80%
5	Ph_2SiH_2	KOH	3 h	–	>97%
6	$PhSiH_3$	KOH	3 h	–	>97%
7	Ph_2SiH_2	NaOH	3 h	15%	84%
8	Ph_2SiH_2	*t*-BuOK	3 h	8%	91%
9	Ph_2SiH_2	K_3PO_4	22 h	8%	90%

[a] *Reaction conditions:* *N*-benzylphthalimide (**1a**, 3 mmol), silanes (2.1 equiv. of H), base (2.5 mol%), DMF (3 mL), 25 °C.
[b] Yields were determined by ^1H NMR analysis (internal standard: 4,4′-di-*tert*-butyl-1,1′-biphenyl).
[c] Reaction temperature: 70 °C.

Table 5. The selective reduction of cyclic imides (**1**) to lactams (**3**) with hydrosilanes.[a]



[a] *Reaction conditions:* imide (**1**, 3.0 mmol), Ph_2SiH_2 (2.1 equiv. of H, 3.15 mmol), KOH (2.5 mol%), DMF (3 mL), 25 °C, isolated yield.
[b] The reduction was conducted on a 5.0 g scale.

To investigate the process of the chemoselective, base-catalyzed reduction of the cyclic imides, the reaction profile for the reduction of the imide (**1a**) with Ph_2SiH_2 (2.1 equiv. of H)/KOH (2.5 mol%) was monitored by ^1H NMR spectroscopy (Figure 1). Build-up and decay of the ω-hydroxylactam derivative is evident during the course of the reduction and supports that the ω-hydroxylactam derivative is an intermediate in the reduction of the imide (**1**) to the lactam (**3**). The conversion of imide (**1a**) was accomplished within five minutes, and the yield of ω-hydroxylactam (**2a**) reached 95% in one minute, while the transformation of ω-hydroxylactam derivative to lactam (**3**) reached completion in about 2 h. These results highlight the very different reactivity of imides compared

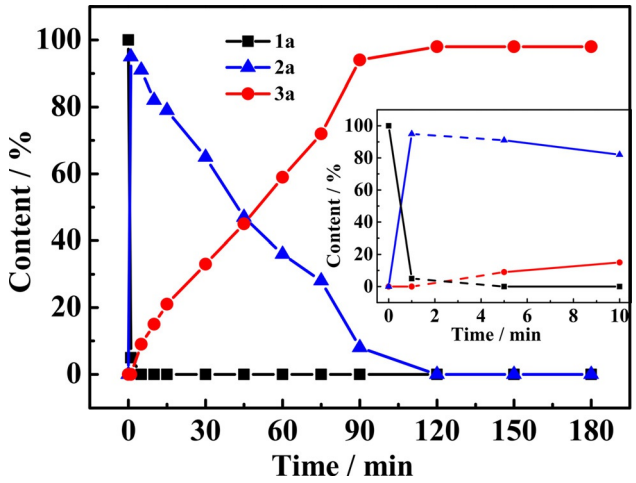


Figure 1. Reaction profiles of the base-catalyzed reduction of *N*-benzylphthalimide (**1a**) with Ph_2SiH_2. *Reaction conditions:* **1a** (3.0 mmol), Ph_2SiH_2 (2.1 equiv. of H, 3.15 mmol), KOH (2.5 mol%), 25 °C, DMF (3 mL) as solvent.

to the ω-hydroxylactam derivative, and support the highly chemoselective experimental findings reported herein.

Conclusions

In summary, the chemoselective reduction of cyclic imides under mild reaction conditions can be achieved with a KOH-catalyzed hydrosilylation system. Various cyclic imides were selectively reduced to ω-hydroxylactams in high yields with PMHS (1.1 equiv. of H) and catalytic amounts of KOH (2.5 mol%). Adjusting the reduction system to Ph_2SiH_2 (2.1 equiv. of H)/KOH (2.5 mol%) selectively provided lactams in good to excellent yields. In addition, this catalytic system exhibited good functional group tolerance.

Experimental Section

Typical Procedure for the Hydrosilylation of Cyclic Imides (1) to the ω-Hydroxylactams (2)

To the mixture of KOH (2.5 mol%) and cyclic imide (3.0 mmol) in DMF (3 mL), was added PMHS (1.1 equiv. based on H) slowly under an atmosphere of nitrogen. The reaction mixture was stirred at 25 °C under an atmosphere of nitrogen. After the imide was consumed completely (detected by TLC), the reaction mixture was quenched by adding $NH_3{\cdot}H_2O$ (1 mL) and stirred at room temperature for one hour. Then the mixture was treated with water (15 mL) and extracted with CH_2Cl_2 (10 mL × 3). The combined organic phase was dried over Na_2SO_4, after removing the solvent under vacuum, the residue was purified by column chromatography to give the product.

2-Benzyl-3-hydroxyisoindolin-1-one (2a):[24] White solid; yield: 653.3 mg (2.7 mmol, 91%); mp 141.7–143.8 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.78–7.77 (m, 1H), 7.58–7.56 (m, 2H), 7.50–7.48 (m, 1H), 7.35–7.31 (m, 5H), 5.63 (d, J = 11.6 Hz, 1H), 5.03 (d, J = 14.8 Hz, 1H), 4.35 (d, J = 14.8 Hz, 1H), 2.63 (d, J = 11.6 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.6, 144.2, 136.8, 132.5, 131.2, 129.8, 128.8, 128.5, 127.8, 123.6, 123.4, 81.1, 42.6.

3-Hydroxy-2-(4-methylbenzyl)isoindolin-1-one (2b): White solid; yield: 713.7 mg (2.8 mmol, 94%); mp 140.8–142.1 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.72–7.71 (m, 1H), 7.56–7.55 (m, 2H), 7.49–7.45 (m, 1H), 7.23–7.21 (m, 2H), 7.12–7.10 (m, 2H), 5.60 (d, J = 11.6 Hz, 1H), 4.92 (d, J = 14.8 Hz, 1H), 4.26 (d, J = 14.8 Hz, 1H), 2.99 (br, 1H), 2.31 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.5, 144.2, 137.4, 133.8, 132.4, 131.3, 129.7, 129.5, 128.6, 123.5, 123.4, 81.0, 42.4, 21.2; HR-MS-ESI: m/z = 254.1184, calculated for $C_{16}H_{15}NO_2$ $(M+H)^+$: 254.1181.

3-Hydroxy-2-[4-(trifluoromethyl)benzyl]isoindolin-1-one (2c): White solid; yield: 921.6 mg (2.7 mmol, 91%); mp 138.6–139.9 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.79–7.76 (m, 1H), 7.59–7.56 (m, 4H), 7.54–7.50 (m, 1H), 7.47–7.45 (m, 2H), 5.63 (d, J = 12.0 Hz, 1H), 5.00 (d, J = 14.8 Hz, 1H), 4.45 (d, J = 14.8 Hz, 1H), 2.72 (d, J = 12.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.7, 144.1, 140.9, 132.8, 131.0, 130.2, 130.0, 129.9, 128.7, 125.86, 125.83, 125.79, 125.75, 125.5, 123.7, 123.5, 122.8, 81.3, 42.34; HR-MS-ESI; m/z = 308.0899, calculated for $C_{16}H_{12}F_3NO_2$ $(M+H)^+$: 308.0898.

2-Ethyl-3-hydroxyisoindolin-1-one (2d):[25] White solid; yield: 489.1 mg (2.8 mmol, 92%); mp 105.0–107.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.63–7.60 (m, 2H), 7.58–7.54 (m, 1H), 7.48–7.43 (m, 1H), 5.77 (d, J = 12.0 Hz, 1H), 3.65–3.56 (m, 1H), 3.40–3.31 (m, 1H), 3.12 (d, J = 12.0 Hz, 1H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.4, 144.1, 132.1, 131.6, 129.6, 123.4, 123.1, 81.3, 33.8, 13.5.

3-Hydroxy-2-isopropylisoindolin-1-one (2e):[26] White solid; yield: 504.8 mg (2.6 mmol, 88%); mp 95.4–97.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.7–7.70 (m, 1H), 7.60–7.54 (m, 2H), 7.51–7.46 (m, 1H), 5.92 (d, J = 11.8 Hz, 1H), 4.45–4.37 (m, 1H), 2.43 (d, J = 11.8 Hz, 1H), 1.43 (d, J = 4.2 Hz, 3H), 1.41 (d, J = 4.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.2, 144.2, 132.0, 129.5, 123.1, 81.4, 44.0, 22.0, 20.2.

1-Benzyl-5-hydroxypyrrolidin-2-one (2f):[27] White solid; yield: 430.2 mg (2.2 mmol, 75%); mp 108.3–110.1 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.36–7.28 (m, 5H), 5.11–5.08 (m, 1H), 4.83 (d, J = 14.8 Hz, 1H), 4.24 (d, J = 14.8 Hz, 1H), 2.68–2.60 (m, 1H), 2.43–2.25 (m, 2H), 2.23–2.21 (m, 1H), 1.93–1.85 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 174.9, 136.6, 128.9, 128.5, 127.8, 82.7, 43.6, 29.0, 28.3.

2-Benzyl-3-hydroxyoctahydro-1*H*-isoindol-1-one (2g): White solid; yield: 735.9 mg (2.7 mmol, 90%); mp 104.2–106.7 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.35–7.28 (m, 5H), 4.81 (d, J = 14.8 Hz, 1H), 4.55 (d, J = 4.8 Hz, 1H), 4.22 (dd, J = 14.8, 4.8 Hz, 1H), 2.84–2.80 (m, 1H), 2.20–2.15 (m, 1H), 2.09–2.05 (m, 1H), 1.69–1.64 (m, 1H), 1.60–1.50 (m, 4H), 1.20–1.14 (m, 2H), 0.96–0.86 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 176.7, 136.8, 128.8, 128.5, 127.7, 85.8, 43.9, 41.0, 38.9, 26.1, 23.4, 23.3, 23.1; HR-MS-ESI: m/z = 246.1492, calculated for $C_{15}H_{19}NO_2$ $(M+H)^+$: 246.1494.

2-Benzyl-3-hydroxyoctahydro-1*H*-4,7-methanoisoindol-1-one (2h):[20] White solid; yield: 632.9 mg (2.5 mmol, 82%); mp 148.5–157.1 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.32–7.26 (m, 5H), 5.08–5.04 (m, 1H), 4.80 (d, J = 14.8 Hz, 1H), 4.25 (d, J = 14.8 Hz, 1H), 2.85–2.81 (m, 1H), 2.70–2.63 (m, 2H), 2.51–2.45 (m, 1H), 2.35–2.33 (m, 1H), 1.78–1.73 (m, 1H), 1.62–1.59 (m, 1H), 1.55–1.47 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 174.5, 136.9, 128.7, 128.6, 127.5, 81.7, 48.6, 44.1, 43.5, 41.7, 40.1, 38.8, 25.3, 24.3.

2-Allyl-3-hydroxyisoindolin-1-one (2i):[28] White solid; yield: 522.2 mg (2.8 mmol, 92%); mp 86.8–89.3 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.61–7.54 (m, 3H), 7.47–7.42 (m, 1H), 5.81–5.71 (m, 2H), 5.21–5.15 (m, 2H), 4.14–4.07 (m, 1H), 3.78–3.72 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.5, 144.2, 132.5, 132.4, 131.2, 129.7, 123.5, 123.3, 118.0, 81.3, 41.4.

5-(1-Hydroxy-3-oxoisoindolin-2-yl)pentanenitrile (2j): Colourless oil; yield: 552.7 mg (2.4 mmol, 80%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.62–7.54 (m, 3H), 7.48–7.44 (m, 1H), 5.74 (s, 1H), 4.09 (br, 1H), 3.52–3.38 (m, 2H), 2.39–2.35 (m, 2H), 1.82–1.72 (m, 2H), 1.70–1.60 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.8, 144.0, 132.4, 131.2, 129.7, 123.4, 123.1, 119.6, 81.9, 38.3, 27.4, 22.7, 16.7; HR-MS-ESI: m/z = 231.1131, calculated for $C_{13}H_{14}N_2O_2$ $(M+H)^+$: 231.1134.

Ethyl 4-(1-hydroxy-3-oxoisoindolin-2-yl)butanoate (2k):[20] Pale yellow oil; yield: 710.9 mg (2.7 mmol, 90%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.68–7.66 (m, 1H), 7.61–7.54 (m, 2H), 7.48–7.44 (m, 1H), 5.78 (d, J = 10.8 Hz, 1H), 4.00 (q, J = 7.2 Hz, 2H), 3.92 (d, J = 10.8 Hz, 1H), 3.60–3.48 (m, 2H), 2.45–2.31 (m, 2H), 2.10–1.91 (m, 2H), 1.18 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 173.6, 167.7, 144.1, 132.2, 131.4, 129.6, 123.4, 123.0, 82.1, 60.6, 38.8, 31.8, 23.7, 14.2.

2-Benzyl-3-hydroxy-2,3,3a,4,7,7a-hexahydro-1*H*-4,7-methanoisoindol-1-one (2l):[29] White solid; yield: 681.6 mg (2.7 mmol, 89%); mp 119.5–126.0 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.32–7.23 (m, 5H), 6.26–6.21 (m, 2H), 5.02–4.97 (m, 1H), 4.65 (d, J = 14.8 Hz, 1H), 4.10 (d, J = 14.8 Hz, 1H), 3.34–3.32 (m, 1H), 3.21–3.18 (m, 1H), 3.09–3.08 (m, 1H), 3.04–3.00 (m, 1H), 1.84–1.80 (m, 1H), 1.63–1.60 (m, 1H), 1.45–1.43 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 173.6, 136.8, 135.9, 134.5, 128.7, 128.5, 127.6, 81.9, 52.3, 49.9, 45.9, 44.7, 43.4, 43.2.

3-(1-Hydroxy-3-oxoisoindolin-2-yl)-*N*,*N*-dimethylpropanamide (2m):[20] White solid; yieldf: 655.5 mg (2.6 mmol, 88%); mp 112.1–115.3 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.76–7.74 (m, 1H), 7.60–7.53 (m, 2H), 7.48–7.44 (m, 1H), 6.20 (d, J = 4.4 Hz, 1H), 5.88 (d, J = 4.4 Hz, 1H), 3.98–3.85 (m, 2H), 3.01 (s, 3H), 2.96 (s, 3H), 2.94–2.89 (m, 1H), 2.68–2.61 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 172.4, 168.0, 144.2, 132.1, 131.7, 129.4, 123.3, 123.0, 82.6, 37.3, 35.9, 35.7, 32.8.

***tert*-Butyl 4-[4-(1-hydroxy-3-oxoisoindolin-2-yl)butyl]piperazine-1-carboxylate (2n):**[20] White solid; yield: 1074.7 mg (2.8 mmol, 92%); mp 108.4–111.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.75–7.73 (m, 1H), 7.61–7.54 (m, 2H), 7.50–7.46 (m, 1H), 5.80 (s, 1H), 3.85–3.81 (m, 1H), 3.52–3.46 (m, 1H), 3.27–3.24 (m, 4H), 2.39–2.33 (m, 1H), 2.31–2.26 (m, 2H), 2.21–2.15 (m, 1H), 2.03–1.99 (m, 3H), 1.73–1.58 (m, 4H), 1.42 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.5, 154.7,

144.7, 132.2, 131.7, 129.7, 123.2, 123.2, 82.8, 79.9, 57.4, 52.7, 40.0, 28.5, 25.9, 24.0.

6-Benzyl-7-hydroxy-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyridin-5-one (2o):[30] White solid; yield: 320.2 mg (1.3 mmol, 46%); mp 183.1–186.7 °C; ^{1}H NMR (400 MHz, DMSO): δ = 8.79–8.77 (m, 1H), 8.12–8.10 (m, 1H), 7.58–7.55 (m, 1H), 7.34–7.32 (m, 4H), 7.30–7.25 (m, 1H), 6.99 (d, J = 8.4 Hz, 1H), 5.64 (d, J = 8.4 Hz, 1H), 4.93 (d, J = 15.6 Hz, 1H), 4.41 (d, J = 15.6 Hz, 1H); ^{13}C NMR (100 MHz, DMSO): δ = 164.8, 163.9, 152.8, 137.5, 131.2, 128.5, 127.8, 127.2, 125.2, 124.7, 80.8, 42.2.

6-Benzyl-5-hydroxy-5*H*-pyrrolo[3,4-*b*]pyridin-7(6*H*)-one (2o′):[30] White solid; yield: 176.7 mg (0.7 mmol, 24%); mp 198.1–202.6 °C; ^{1}H NMR (400 MHz, DMSO): δ = 8.77–8.75 (m, 1H), 8.05–8.03 (m, 1H), 7.62–7.59 (m, 1H), 7.34–7.32 (m, 4H), 7.30–7.25 (m, 1H), 6.89 (d, J = 8.8 Hz, 1H), 5.74 (d, J = 8.8 Hz, 1H), 4.94 (d, J = 15.6 Hz, 1H), 4.42 (d, J = 15.6 Hz, 1H); ^{13}C NMR (100 MHz, DMSO): δ = 164.7, 151.4, 149.8, 139.2, 137.4, 132.2, 128.5, 127.8, 127.2, 126.1, 78.5, 42.4.

1-(5,5-Dimethoxypentyl)-5-hydroxypyrrolidin-2-one (2t):[23] Pale yellow oil; yield: 490.9 mg (2.6 mmol, 87%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 5.21 (t, J = 5.6 Hz, 1H), 4.34 (t, J = 6.0 Hz, 1H), 3.49–3.42 (m, 1H), 3.30 (s, 6H), 3.21–3.14 (m, 1H), 2.57–2.51 (m, 1H), 2.37–2.26 (m, 2H), 1.92–1.85 (m, 1H), 1.75 (br, 1H), 1.64–1.55 (m, 4H), 1.41–1.33 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 175.0, 104.5, 83.2, 52.9, 39.8, 32.2, 29.1, 28.3, 27.5, 22.0.

Typical Procedure for the Hydrosilylation of Cyclic Imides (1) to the Lactams (3)

To the mixture of KOH (2.5 mol%) and cyclic imide (3.0 mmol) in DMF, was added Ph_2SiH_2 (2.1 equiv. based on H) slowly under an atmosphere of nitrogen. The reaction mixture was stirred at 25 °C under an atmosphere of nitrogen. After the imide was consumed completely (detected by TLC), the reaction mixture was quenched by adding $NH_3{\cdot}H_2O$ (1 mL) and stirred at room temperature for one hour. Then the mixture was treated with water (15 mL) and extracted with CH_2Cl_2 (10 mL × 3). The combined organic phase was dried over Na_2SO_4, after removing the solvent under vacuum, the residue was purified by column chromatography to give the product.

2-Benzylisoindolin-1-one (3a):[19] Pale yellow solid; yield: 602.9 mg (2.7 mmol, 90%); mp 83.3–84.5 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.91–7.89 (m, 1H), 7.54–7.45 (m, 2H), 7.39–7.36 (m, 1H), 7.34–7.26 (m, 5H), 4.81 (s, 2H), 4.27 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.5, 141.3, 137.1, 132.7, 131.4, 128.8, 128.2, 128.1, 127.7, 123.9, 122.8, 49.5, 46.4.

2-(4-Methylbenzyl)isoindolin-1-one (3b): Pale yellow solid; yield: 640.7 mg (2.7 mmol, 89%); mp 64.3–66.4 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.89–7.87 (m, 1H), 7.51–7.42 (m, 2H), 7.36–7.34 (m, 1H), 7.20–7.18 (m, 2H), 7.14–7.12 (m, 2H), 4.75 (s, 2H), 4.22 (s, 2H), 2.32 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.4, 141.3, 137.4, 134.0, 132.7, 131.3, 129.5, 128.2, 128.0, 123.8, 122.8, 49.4, 46.1, 21.1; HR-MS-ESI: m/z = 238.1232, calculated for $C_{16}H_{15}NO$ $(M+H)^+$: 238.1232.

2-[4-(Trifluoromethyl)benzyl]isoindolin-1-one (3c): Pale yellow solid; yield: 454.4 mg (1.6 mmol, 52%); mp 122.2–124.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.92–7.90 (m, 1H), 7.60–7.58 (m, 2H), 7.57–7.47 (m, 2H), 7.43–7.40 (m, 3H), 4.87 (s, 2H), 4.29 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.7, 141.3, 141.2, 132.4, 131.7, 130.6, 130.3, 129.9, 129.6, 128.4, 128.3, 125.9, 125.9, 125.9, 125.8, 125.5, 124.1, 123.0, 122.8, 49.6, 46.1; HR.MS-ESI: m/z = 292.0951, calculated for $C_{16}H_{12}F_3NO$ $(M+H)^+$: 292.0949.

2-Ethylisoindolin-1-one (3d):[19] Pale yellow oil; yield: 451.4 mg (2.8 mmol, 92%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.85–7.82 (m, 1H), 7.53–7.49 (m, 1H), 7.46–7.42 (m, 2H), 4.37 (s, 2H), 3.67 (q, J = 7.2 Hz, 2H), 1.26 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.1, 141.1, 133.0, 131.0, 127.9, 123.4, 122.6, 49.2, 36.9, 13.5.

2-Isopropylisoindolin-1-one (3e):[19] White solid; yield: 473.0 mg (2.7 mmol, 90%); mp 89.3–91.6 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.85–7.83 (m, 1H), 7.54–7.50 (m, 1H), 7.46–7.43 (m, 2H), 4.73–4.63 (m, 1H), 4.34 (s, 2H), 1.30 (s, 3H), 1.28 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.9, 141.2, 133.4, 131.1, 128.0, 123.6, 122.8, 45.1, 42.7, 20.9.

2-Allylisoindolin-1-one (3i): Pale yellow oil; yield: 441.7 mg (2.5 mmol, 85%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.86–7.84 (m, 1H), 7.55–7.50 (m, 1H), 7.47–7.42 (m, 2H), 5.91–5.81 (m, 1H), 5.26–5.20 (m, 2H), 4.35 (s, 2H), 4.24–4.22 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.2, 141.2, 133.0, 132.7, 131.3, 127.9, 123.7, 122.7, 117.9, 49.5, 45.0; HR-MS-ESI: m/z = 174.0914, calculated for $C_{11}H_{11}NO$ $(M+H)^+$: 174.0919.

5-(1-Oxoisoindolin-2-yl)pentanenitrile (3j): Pale yellow oil; yield: 572.2 mg (2.7 mmol, 89%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.80–7.78 (m, 1H), 7.53–7.49 (m, 1H), 7.44–7.41 (m, 2H), 4.35 (s, 2H), 3.64 (t, J = 7.2 Hz, 2H), 2.42 (t, J = 7.2 Hz, 2H), 1.85–1.78 (m, 2H), 1.71–1.63 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.8, 141.0, 132.5, 131.4, 128.1, 123.6, 122.8, 119.4, 49.8, 41.0, 27.2, 22.4, 16.7; HR-MS-ESI: m/z = 215.1179, calculated for $C_{13}H_{14}N_2O$ $(M+H)^+$: 215.1184.

Ethyl 4-(1-oxoisoindolin-2-yl)butanoate (3k): Pale yellow oil; yield: 430.3 mg (1.7 mmol, 58%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.84–7.82 (m, 1H), 7.54–7.50 (m, 1H), 7.46–7.43 (m, 2H), 4.39 (s, 2H), 4.06 (q, J = 7.2 Hz, 2H), 3.66 (t, J = 7.2 Hz, 2H), 2.38 (t, J = 7.2 Hz, 2H), 2.00 (p, J = 7.2 Hz, 2H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 173.1, 168.7, 141.2, 132.7, 131.3, 128.0, 123.6, 122.7, 60.5, 50.0, 41.7, 31.5, 23.7, 14.2; HR-MS-ESI: m/z = 248.1286, calculated for $C_{14}H_{17}NO_3$ $(M+H)^+$: 248.1287.

***N*,*N*-Dimethyl-3-(1-oxoisoindolin-2-yl)propanamide (3m):** Pale yellow solid; yield: 206.7 mg (2.7 mmol, 89%); mp 99.8–102.4 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.82–7.81 (m, 1H), 7.53–7.49 (m, 1H), 7.45–7.41 (m, 2H), 4.55 (s, 2H), 3.92 (t, J = 6.4 Hz, 2H), 2.99 (s, 3H), 2.93 (s, 3H), 2.76 (t, J = 6.4 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 170.9, 168.9, 141.8, 132.7, 131.2, 127.8, 123.3, 122.7, 51.6, 38.9, 37.2, 35.4, 32.4; HR-MS-ESI: m/z = 233.1292, calculated for $C_{13}H_{16}N_2O_2$ $(M+H)^+$: 233.1290.

***tert*-Butyl 4-[4-(1-oxoisoindolin-2-yl)butyl]piperazine-1-carboxylate (3n):** Pale yellow solid; 986.0 mg (2.6 mmol, 88%); mp 99.1–102.1 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.84–7.82 (m, 1H), 7.54–7.50 (m, 1H), 7.47–7.42 (m, 2H), 4.37 (s, 2H), 3.64 (t, J = 7.2 Hz, 2H), 3.40 (t, J = 4.8 Hz, 2H), 2.39–2.35 (m, 6H), 1.73–1.66 (m, 2H), 1.57–1.50 (m, 2H), 1.44 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.5, 154.7, 141.0, 132.9, 131.2, 128.0, 123.6, 122.6, 79.5, 58.0, 53.0, 49.8,

43.7, 43.3, 42.1, 28.4, 26.2, 24.0; HR-MS-ESI: m/z = 374.2441, calculated for $C_{21}H_{31}N_3O_3$ $(M+H)^+$: 374.2444.

6-Benzyl-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyridin-5-one (3o):[31] Pale yellow solid; yield:195.1 mg (0.9 mmol, 29%); mp 136.1–138.7 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.71–8.69 (m, 1H), 8.16–8.14 (m, 1H), 7.42–7.38 (m, 1H), 7.37–7.30 (m, 5H), 4.84 (s, 2H), 4.34 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.8, 162.3, 152.6, 136.6, 132.0, 129.0, 128.3, 128.0, 126.5, 123.3, 51.2, 46.4.

6-Benzyl-5*H*-pyrrolo[3,4-*b*]pyridin-7(6*H*)-one (3o′):[32] Pale yellow solid; yield: 157.8 mg (0.7 mmol, 23%); mp 153.2–155.1 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.80–8.79 (m, 1H), 7.76–7.74 (m, 1H), 7.43–7.39 (m, 1H), 7.37–7.30 (m, 5H), 4.87 (s, 2H), 4.27 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 166.5, 151.0, 150.8, 136.5, 135.2, 131.3, 129.0, 128.5, 128.0, 125.3, 47.3, 47.0.

Ethyl 3-(1-oxoisoindolin-2-yl)propanoate (3p): Pale yellow oil; yield: 233.3 mg (1.0 mmol, 33%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.85–7.83 (m, 1H), 7.55–7.51 (m, 1H), 7.47–7.42 (m, 2H), 4.47 (s, 2H), 4.15 (q, J = 7.2 Hz, 2H), 3.91 (t, J = 6.4 Hz, 2H), 2.73 (t, J = 6.4 Hz, 2H), 1.24 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 172.1, 168.8, 141.5, 134.6, 131.5, 128.2, 123.8, 122.8, 61.0, 51.0, 38.7, 33.7, 14.3; HR-MS-ESI: m/z = 234.1134, calculated for $C_{13}H_{15}NO_3$ $(M+H)^+$: 234.1130.

Ethyl 5-(1-oxoisoindolin-2-yl)pentanoate (3q): Colourless oil; yield: 376.6 mg (1.4 mmol, 48%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.82–7.80 (m, 1H), 7.52–7.48 (m, 1H), 7.44–7.40 (m, 2H), 4.36 (s, 2H), 4.08 (q, J = 7.2 Hz, 2H), 3.61 (t, J = 6.8 Hz, 2H), 2.34 (t, J = 6.8 Hz, 2H), 1.69–1.65 (m, 4H), 1.21 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 173.4, 168.6, 141.2, 133.0, 131.2, 128.1, 123.7, 122.7, 60.4, 49.9, 41.9, 33.8, 27.8, 22.2, 14.3; HR-MS-ESI: m/z = 262.1441, calculated for $C_{15}H_{19}NO_3$ $(M+H)^+$: 262.1443.

6-Benzyl-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one (3r): Pale yellow solid; yield: 283.7 mg (1.3 mmol, 42%); mp 189.3–191.8 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.77 (d, J = 2.4 Hz, 1H), 8.65 (d, J = 2.4 Hz, 1H), 7.39–7.32 (m, 5H), 4.90 (s, 2H), 4.37 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 164.8, 156.3, 146.4, 145.9, 145.0, 136.0, 129.1, 128.5, 128.3, 48.7, 47.0; HR-MS-ESI: m/z = 226.0976, calculated for $C_{13}H_{11}N_3O$ $(M+H)^+$: 226.0980.

2-Methyl-7-propylisoindolin-1-one (3s): Pale yellow solid; yield: 283.9 mg (1.5 mmol, 50%); mp 49.6–51.2 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.41–7.37 (m, 1H), 7.24–7.18 (m, 2H), 4.31 (s, 2H), 3.16 (s, 3H), 3.13 (t, J = 7.2 Hz, 2H), 1.74–1.64 (m, 2H), 0.98 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.2, 142.4, 141.7, 130.7, 129.5, 129.1, 120.1, 51.4, 32.8, 29.2, 24.8, 14.1; HR-MS-ESI: m/z = 190.1232, calculated for $C_{12}H_{15}NO$ $(M+H)^+$: 190.1232.

2-Methyl-4-propylisoindolin-1-one (3s′): Pale yellow oil; yield: 255.4 mg (1.4 mmol, 45%); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.68–7.66 (m, 1H), 7.40–7.37 (m, 1H), 7.33–7.31 (m, 1H), 4.33 (s, 2H), 3.20 (s, 3H), 2.61 (t, J = 7.2 Hz, 2H), 1.73–1.63 (m, 2H), 0.97 (t, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.2, 139.5, 137.0, 132.7, 131.2, 128.3, 121.2, 51.3, 34.1, 29.5, 23.2, 14.0; HR-MS-ESI: m/z = 190.1228, calculated for $C_{12}H_{15}NO$ $(M+H)^+$: 190.1232.

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