This article was downloaded by: [Korea University] On: 28 December 2014, At: 09:30 Publisher: Taylor & Francis Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



# Phosphorus, Sulfur, and Silicon and the Related Elements

Publication details, including instructions for authors and subscription information: http://www.tandfonline.com/loi/gpss20

Vinylphosphonium Salt Mediated Preparation of Substituted Imides and Furans from Benzoic Acid, 1,1,3,3-Tetramethylbutyl Isocyanide, and Acetylenic Esters

Ali Ramazani<sup>a</sup> & Mohsen Valizadeh Holagh<sup>b</sup>

<sup>a</sup> Chemistry Department, Islamic Azad University, Zanjan Branch, Zanjan, Iran

<sup>b</sup> Chemistry Department, Zanjan University, Zanjan, Iran Published online: 19 Dec 2008.

To cite this article: Ali Ramazani & Mohsen Valizadeh Holagh (2008) Vinylphosphonium Salt Mediated Preparation of Substituted Imides and Furans from Benzoic Acid, 1,1,3,3-Tetramethylbutyl Isocyanide, and Acetylenic Esters, Phosphorus, Sulfur, and Silicon and the Related Elements, 184:1, 171-178, DOI: 10.1080/10426500802081202

To link to this article: http://dx.doi.org/10.1080/10426500802081202

### PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views

expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <u>http://www.tandfonline.com/page/terms-and-conditions</u>



#### Vinylphosphonium Salt Mediated Preparation of Substituted Imides and Furans from Benzoic Acid, 1,1,3,3-Tetramethylbutyl Isocyanide, and Acetylenic Esters

Ali Ramazani<sup>1</sup> and Mohsen Valizadeh Holagh<sup>2</sup>

<sup>1</sup>Chemistry Department, Islamic Azad University–Zanjan Branch, Zanjan, Iran

<sup>2</sup>Chemistry Department, Zanjan University, Zanjan, Iran

Protonation of the reactive intermediates produced in the reaction between triphenylphosphine and dialkyl acetylenedicarboxylates by benzoic acid leads to vinyltriphenylphosphonium salts, which undergo complex reactions with 1,1,3,3tetramethylbutyl isocyanide to produce corresponding substituted furans and imides in fairly good yields in a stereoselective manner.

**Keywords** Acetylenic ester; densely functionalized furan; electron-poor imide; phosphorus ylide; triphenylphosphine

#### INTRODUCTION

Organophosphorus compounds<sup>1,2</sup> have been extensively employed in organic synthesis as useful reagents as well as ligands in a number of transition metal catalysts.<sup>3</sup> Phosphorus ylides are a class of a special type of zwitterions, which bear strongly nucleophilic electron-rich carbanions. The electron distribution around the  $P^+ - C^-$  bond and its consequent chemical implications has been probed and assessed through theoretical, spectroscopic, and crystallographic investigations.<sup>4</sup> They are excellent ligands and excel in their ligating functions with the unstabilized ylides because of their ambidentate and chemically differentiating character. Proton affinity of these ylides can be used as a molecular guide to assess their utility as synthetic reagents and their function as ligands in coordination and organometallic chemistry.<sup>3,5</sup>

Received 4 November 2007; accepted 30 December 2007.

This work was supported by the Zanjan University.

Address correspondence to Ali Ramazani, Chemistry Department, Islamic Azad University-Zanjan Branch, P.O. Box 49195-467, Zanjan, Iran. E-mail: aliramazani@ gmail.com

The nucleophilicity at the ylidic carbon is a factor of essential mechanistic importance in the use of these ylides as Wittig reagents. Phosphorus ylides are important reagents in synthetic organic chemistry, especially in the synthesis of naturally occurring products, and compounds with biological and pharmacological activity.<sup>1,2</sup> In recent years, we have established a one-pot method for the synthesis of stabilized ylides.<sup>6–15</sup>

For several years acetylenic esters have attracted the attention of organic chemists and are reactive systems that can take part in many chemical syntheses,<sup>16–18</sup> almost as a Michael acceptor in the organic reactions.<sup>16</sup> In recent years, there has been increasing interest in the applications of acetylenic esters in the multicomponent<sup>19–21</sup> synthesis. Due to the atom economy, convergent character, and simplicity of onepot procedures, multicomponent condensation reactions (MCRs) have an advantageous position among other reactions. The development of novel MCRs is receiving growing interest from industrial chemistry research groups and represents a challenge for organic chemists.<sup>22–26</sup> As part of our ongoing program to develop efficient and robust methods for the preparation of heterocyclic compounds,<sup>27–37</sup> we sought to develop a convenient preparation of densely functionalized furans **5** and imides **4** in fairly good yields in neutral conditions.

#### **RESULTS AND DISCUSSION**

Protonation of the reactive intermediates produced in the reaction between triphenylphosphine and dialkyl acetylenedicarboxylates 2 by benzoic acid 3 leads to vinyltriphenylphosphonium salts 7, which undergo complex reactions with 1,1,3,3-tetramethylbutyl isocyanide 1 to produce corresponding densely functionalized furans 5 and imides 4 in fairly good yields in neutral conditions (Schemes 1 and 2). The reaction proceeds smoothly and cleanly under reaction conditions, and no side reactions were observed. The reactions were completed in 48 h, and densely functionalized furans 5 were observed as major products (Table I). In this reaction, triphenylphosphine acts as a catalyst. In the absence of the triphenylphosphine,<sup>25,26</sup> the reactions were completed after 72 h in CH<sub>2</sub>Cl<sub>2</sub> at room temperature with imides 4 observed as major products (Table I).<sup>25,26</sup> The <sup>1</sup>H NMR (CDCl<sub>3</sub>) spectra of compounds 4 show the presence of one estereoisomer  $(\mathbf{E})$  for each imides 4. Z isomers of the imides 4 were not isolated. It seems that Z isomers 12 are more reactive than E isomers toward formation of adduct 13 with 1,1,3,3-tetramethylbutyl isocyanide 1 and act as intermediate in the formation of furans 5 (Scheme 2). The reaction is stereoselective.

TABLE I Synthesis of Imides 4 and F	Furans 5 (see Scheme 1	1)
-------------------------------------	------------------------	----

Entry	Products	In the presence of PPh <sub>3</sub> ( r. t., 48 h.): Total isolated yield $\%$ (4 + 5); Ratio of 4:5		In the absence of PPh <sub>3</sub> ( r. t., 72 h.): Total isolated yield $\%$ (4 + 5); Ratio of 4:5	
1	4a/5a	91;	31:69	80;	90:10
2	4b/5b	85;	30:70	75;	83;17



#### **SCHEME 1**

The mechanism of the reaction between the triphenylphosphine, 1,1,3,3-tetramethylbutyl isocyanide (1) dialkyl acetylenedicarboxylates (2), and benzoic acid (3) has not been established experimentally. However, a possible explanation is proposed in Scheme 2. The structures of the products were deduced from their IR, <sup>1</sup>H NMR, and <sup>13</sup>C NMR spectra (see the Experimental section).

#### CONCLUSIONS

In summary, we have found a new and efficient method for preparing electron-poor imides (4) and fully substituted furans (5) from



#### **SCHEME 2**

triphenylphosphine, 1,1,3,3-tetramethylbutyl isocyanide (1) dialkyl acetylenedicarboxylates (2), and benzoic acid (3) in neutral conditions (Scheme 1, Scheme 2, and Table I). We believe the reported method offers a simple and efficient route for the preparation of electron-poor

imides (4) and fully substituted furans (5) (Scheme 1). Its ease of workup and fairly good yields make it a useful addition to modern synthetic methodologies.Other aspects of this process are under investigation.

#### EXPERIMENTAL

<sup>1</sup>H (250.13 MHz) and <sup>13</sup>C (62.90 MHz) NMR measurements were recorded on a Brucker 250 spectrometer in  $\text{CDCl}_3$  with tetramethylsilane as internal standard. IR spectra were measured on a Mattson-1000 FTIR spectrophotometer. Starting materials and solvents were obtained from Merck (Germany) and Fluka (Switzerland) and were used without further purification. Flash chromatography columns were prepared from Merck silica gel powder.

#### General Procedure for the Preparation of Compounds 4a–b and 5a–b

To a magnetically stirred solution of triphenylphosphine (0.262 g, 1 mmol) and benzoic acid **3** (0.28 g, 2 mmol) in dry  $CH_2Cl_2$  (1 ml) was added dropwise a solution of **2** (2 mmol) in  $CH_2Cl_2$  (2 mL) at  $-10^{\circ}C$  over 15 min. The mixture was allowed to warm to room temperature and to it was added dropwise a solution of 1,1,3,3-tetramethylbutyl isocyanide **1** (3 mmol) in  $CH_2Cl_2$  (1 mL) over 10 min. The mixture was stirred for 48 h. The solvent was removed under reduced pressure, and the viscous residue was purified by flash column chromatography (silica gel; light petroleum ether-ethyl acetate). Characterization data are given in the next section.

#### Dimethyl (E)-2-{[benzoyl(1,1,3,3-tetramethylbutyl)amino]carbonyl}-2-butenedioate 4a

Viscous yellow oil, IR (KBr) ( $\upsilon_{max}$ , cm<sup>-1</sup>): 1738 (OCNCO), 1669 (CO<sub>2</sub>Me), 1600 (C=C), 1546 and 1454 (Ph), 1369, 1253, 1200 and 1123 (C–O).<sup>1</sup>H NMR (250.13 MHz, CDCl<sub>3</sub>):  $\delta_{\rm H}$  0.99 (9 H, s, CMe<sub>3</sub>), 1.55 (6 H, s, CMe<sub>2</sub>), 2.30 (2 H, s, CH<sub>2</sub>), 3.54 (3 H, OMe), 3.70 (3 H, s, OMe), 6.28 (1 H, NH), 7.30 (2 H, dd, <sup>3</sup>J<sub>HH</sub> = 7.5 Hz, <sup>3</sup>J<sub>HH</sub> = 7.5 Hz, 2 CH<sub>meta</sub> of C<sub>6</sub>H<sub>5</sub>), 7.45 (1 H, t, <sup>3</sup>J<sub>HH</sub> = 7.7 Hz, CH<sub>para</sub> of C<sub>6</sub>H<sub>5</sub>), 7.68 (2 H, d, <sup>3</sup>J<sub>HH</sub> = 7.7 Hz, 2 CH<sub>ortho</sub> of C<sub>6</sub>H<sub>5</sub>). <sup>13</sup>C NMR (62.90 MHz, CDCl<sub>3</sub>):  $\delta_{\rm C}$  22.59 (CMe<sub>3</sub>), 28.23 (CH<sub>3</sub> of CMe<sub>2</sub>), 31.66 (CH<sub>3</sub> of CMe<sub>3</sub>), 50.44 (CH<sub>2</sub>), 52.21 (OMe), 52.53 (OMe), 64.91 (C of CMe<sub>2</sub>), 128.15 (2 CH<sub>meta</sub> of C<sub>6</sub>H<sub>5</sub>), 128.43 (2 CH<sub>ortho</sub> of C<sub>6</sub>H<sub>5</sub>), 130.38 (C=CH), 134.03 (CH<sub>para</sub> of C<sub>6</sub>H<sub>5</sub>), 136.04 (C<sub>ipso</sub> of C<sub>6</sub>H<sub>5</sub>), 140.99 (C=CH), 161.68 (PhCONCO), 162.77 (CO<sub>2</sub>Me), 163.53 (CO<sub>2</sub>Me), 175.11 (PhCON).

#### Diethyl (E)-2-{[benzoyl(1,1,3,3-tetramethylbutyl)amino]carbonyl}-2-butenedioate 4b

Viscous yellow oil, IR (KBr) ( $\nu_{max}$ , cm<sup>-1</sup>): 1730 (OCNCO), 1676 (CO<sub>2</sub>Me), 1610 (C=C), 1553 and 1469 (Ph), 1376, 1261, 1200 and 1161 (C–O).<sup>1</sup>H NMR (250.13 MHz, CDCl<sub>3</sub>):  $\delta_{\rm H}$  1.07 (9 H, s, CMe<sub>3</sub>), 1.25 (3 H, t,<sup>3</sup>J<sub>HH</sub> = 7.2 Hz, CH<sub>3</sub>), 1.28 (3 H, t,<sup>3</sup>J<sub>HH</sub> = 7.2 Hz, CH<sub>3</sub>), 1.65 (6 H, s, CMe<sub>2</sub>), 2.38 (2 H, s, CH<sub>2</sub>), 4.11 (2 H, q,<sup>3</sup>J<sub>HH</sub> = 7.2 Hz, OCH<sub>2</sub>CH<sub>3</sub>), 4.22 (2 H, q,<sup>3</sup>J<sub>HH</sub> = 7.2 Hz, OCH<sub>2</sub>CH<sub>3</sub>), 6.33 (1 H, s, NH), 7.40 (2 H, dd, <sup>3</sup>J<sub>HH</sub> = 7.5 Hz, <sup>3</sup>J<sub>HH</sub> = 7.5 Hz, 2CH<sub>meta</sub> of C<sub>6</sub>H<sub>5</sub>), 7.54 (1 H, t, <sup>3</sup>J<sub>HH</sub> = 7.4 Hz, CH<sub>para</sub> of C<sub>6</sub>H<sub>5</sub>), 7.78 (2 H, d, <sup>3</sup>J<sub>HH</sub> = 7.4 Hz, 2 CH<sub>ortho</sub> of C<sub>6</sub>H<sub>5</sub>).<sup>13</sup>C NMR (62.90 MHz, CDCl<sub>3</sub>):  $\delta_{\rm C}$  13.76 (CH<sub>3</sub>CH<sub>2</sub>), 14.08 (CH<sub>3</sub>CH<sub>2</sub>), 28.59 (CMe<sub>3</sub>), 31.58 (CH<sub>3</sub> of CMe<sub>2</sub>), 31.77 (CH<sub>3</sub> of CMe<sub>3</sub>), 50.41(CH<sub>2</sub>), 61.49 (OCH<sub>2</sub>), 62.18 (OCH<sub>2</sub>), 65.12 (C of CMe<sub>2</sub>), 128.45 (2 CH<sub>meta</sub> of C<sub>6</sub>H<sub>5</sub>), 130.41 (C=CH), 134.00 (CH<sub>para</sub> of C<sub>6</sub>H<sub>5</sub>), 136.40 (C<sub>ipso</sub> of C<sub>6</sub>H<sub>5</sub>), 141.74 (C=CH), 162.15 (PhCONCO), 162.63 (CO<sub>2</sub>Me), 163.41 (CO<sub>2</sub>Me), 175.39 (PhCON).

## *Dimethyl 2-[Benzoyl(1,1,3,3-tetramethylbutyl)amino]-5-(1,1,3,3-tetramethylbutylamino)-3,4-furandicarboxylate 5a*

Viscous yellow oil, IR (KBr) ( $\nu_{max}$ , cm<sup>-1</sup>): 3485 (NH), 1730 (CO<sub>2</sub>Me), 1669 (CO<sub>2</sub>Me), 1576 CON), 1215 (C–O).<sup>1</sup>H NMR (250.13 MHz, CDCl<sub>3</sub>):  $\delta_{\rm H}$  1.04 (9 H, s, CMe<sub>3</sub>), 1.11 (9 H, s, CMe<sub>3</sub>), 1.40 (3 H, s, CMe<sub>2</sub>), 1.50 (3 H, s, CMe<sub>2</sub>), 1.52 (3 H, s, CMe<sub>2</sub>), 1.54 (3 H, s, CMe<sub>2</sub>), 1.60 (2 H, s, CH<sub>2</sub>), 1.90 (1 H, d, <sup>2</sup> J<sub>HH</sub> = 15.0 Hz, CH<sub>2</sub>), 1.75 (1 H, d, <sup>2</sup> J<sub>HH</sub> = 15.0 Hz, CH<sub>2</sub>), 3.63 (3 H, s, OMe), 3.75 (3 H, s, OMe), 7.07 (1 H, s, NH), 7.22 (2 H, d, <sup>3</sup> J<sub>HH</sub> = 7.0 Hz, 2 CH<sub>ortho</sub> of C<sub>6</sub>H<sub>5</sub>), 7.27 (1 H, t, <sup>3</sup> J<sub>HH</sub> = 7.0 Hz, CH<sub>para</sub> of C<sub>6</sub>H<sub>5</sub>), 7.44 (2 H, t, <sup>3</sup> J<sub>HH</sub> = 7.5 Hz, 2 CH<sub>meta</sub> of C<sub>6</sub>H<sub>5</sub>).<sup>13</sup>C NMR (62.90 MHz, CDCl<sub>3</sub>):  $\delta_{\rm C}$  28.11 (CMe<sub>3</sub>), 28.79 (CMe<sub>3</sub>), 30.01 (CH<sub>3</sub> of CMe<sub>2</sub>), 30.18 (CH<sub>3</sub> of CMe<sub>2</sub>), 31.44 (CH<sub>3</sub> of CMe<sub>3</sub>), 31.66 (CH<sub>3</sub> of CMe<sub>3</sub>), 31.73 (CH<sub>2</sub>), 49.33 (CMe<sub>2</sub>), 50.90 (CMe<sub>2</sub>), 51.80 (OMe), 53.01 (OMe), 56.18 (CH<sub>2</sub>), 65.69 (CH<sub>2</sub>), 85.59 (C4 of furan), 114.76 (C3 of furan), 127.28 (CH<sub>para</sub> of C<sub>6</sub>H<sub>5</sub>), 127.62 (2 CH<sub>ortho</sub> of C<sub>6</sub>H<sub>5</sub>), 129.83 (2 CH<sub>meta</sub> of C<sub>6</sub>H<sub>5</sub>), 138.32 (C<sub>ipso</sub> of C<sub>6</sub>H<sub>5</sub>), 139.89 (C5 of furan), 159.02 (C2 of furan), 163.62 (CO<sub>2</sub>Me), 165.13 (CO<sub>2</sub>Me), 172.20 (NCO).

#### Diethyl 2-[Benzoyl(1,1,3,3-tetramethylbutyl)amino]-5-(1,1,3,3tetramethylbutylamino)-3,4-furandicarboxylate 5b

Viscous yellow oil, IR (KBr) ( $\nu_{max}$ , cm<sup>-1</sup>): 3492 (NH), 1746 (CO<sub>2</sub>Me), 1684 (CO<sub>2</sub>Me), 1569 (CON), 1230 (C–O).<sup>1</sup>H NMR (250.13 MHz, CDCl<sub>3</sub>):  $\delta_{\rm H}$  1.03 (9 H, s, CMe<sub>3</sub>), 1.10 (9 H, s, CMe<sub>3</sub>), 1.18 (3 H, t, <sup>3</sup>J<sub>HH</sub> = 7.0 Hz, CH<sub>3</sub>), 1.29 (3 H, t, <sup>3</sup>J<sub>HH</sub> = 7.0 Hz, CH<sub>3</sub>), 1.40 (3 H, s, CMe<sub>2</sub>), 1.51 (3 H, s, CMe<sub>2</sub>), 1.55 (6 H, s, CMe<sub>2</sub>), 1.60 (2 H, m, CH<sub>2</sub>), 1.71 (2 H, d, <sup>1</sup>J = 15.0

Hz, CH<sub>2</sub>), 1.86 (2 H, d,  ${}^{1}J = 15.0$  Hz, CH<sub>2</sub>), 4.11 (3 H, m, OEt), 4.32 (3 H, m, OEt), 7.02 (1 H, s, NH), 7.12 (2 H, d,  ${}^{3}J_{HH} = 7$  Hz, 2 CH<sub>ortho</sub> of C<sub>6</sub>H<sub>5</sub>), 7.26 (1 H, t,  ${}^{3}J_{HH} = 7$  Hz, CH<sub>para</sub> of C<sub>6</sub>H<sub>5</sub>), 7.46 (2 H, t,  ${}^{3}J_{HH} = 7.5$  Hz, 2 CH<sub>meta</sub> of C<sub>6</sub>H<sub>5</sub>).  ${}^{13}$ C NMR (62.90 MHz, CDCl<sub>3</sub>):  $\delta_{\rm C}$  14.04 (CH<sub>3</sub>), 14.17 (CH<sub>3</sub>), 28.12 (CMe<sub>3</sub>), 28.94 (CMe<sub>3</sub>), 30.03 (CH<sub>3</sub> of CMe<sub>2</sub>), 30.20 (CH<sub>3</sub> of CMe<sub>2</sub>), 31.45 (CH<sub>3</sub> of CMe<sub>3</sub>), 31.62 (CH<sub>3</sub> of CMe<sub>3</sub>), 31.65 (CH<sub>2</sub>), 49.35 (CMe<sub>2</sub>), 52.98 (CMe<sub>2</sub>), 56.11 (OEt), 59.57 (OEt), 61.17 (CH<sub>2</sub>), 65.67 (CH<sub>2</sub>), 85.91 (C4 of furan), 115.2 (C3 of furan), 127.42 (CH<sub>para</sub> of C<sub>6</sub>H<sub>5</sub>), 127.59 (2 CH<sub>ortho</sub> of C<sub>6</sub>H<sub>5</sub>), 129.77 (2 CH<sub>meta</sub> of C<sub>6</sub>H<sub>5</sub>), 138.22 (C<sub>ipso</sub> of C<sub>6</sub>H<sub>5</sub>), 139.07 (C5 of furan), 158.88 (C2 of furan), 164.75 (CO<sub>2</sub>Me), 165.13 (CO<sub>2</sub>Me), 172.13 (NCO).

#### REFERENCES

- O. I. Kolodiazhnyi, Phosphorus Ylides: Chemistry and Applications in Organic Chemistry (Wiley, New York, 1999).
- [2] D. E. C. Cobridge, Phosphorus: An Outline of Chemistry, Biochemistry and Uses (Elsevier, Amsterdam, 1995), 5th ed.
- [3] W. C. Kaska, Coord. Chem. Rev., 48, 1 (1983).
- [4] A. Ramazani, A. R. Kazemizadeh, E. Ahmadi, K. Slepokura, and T. Lis, Z. Naturforsch., 61b, 1128 (2006).
- [5] B. E. Maryanoff and A. B. Reitz, Chem. Rev., 89, 863 (1989).
- [6] I. Yavari and A. Ramazani, Synth. Commun., 26, 4495 (1996).
- [7] I. Yavari and A. Ramazani, Phosphorus, Sulfur, and Silicon, 130, 73 (1997).
- [8] A. Ramazani and A. Bodaghi, Tetrahedron Lett., 41, 567 (2000).
- [9] P. Pakravan, A. Ramazani, N. Noshiranzadeh, and A. Sedrpoushan, *Phosphorus*, Sulfur, and Silicon, 182, 545 (2007).
- [10] A. Ramazani, M. Rahimifard, and A. Souldozi, *Phosphorus, Sulfur, and Silicon*, 182, 1 (2007).
- [11] A. Ramazani, M. Rahimifard, N. Noshiranzadeh, and A. Souldozi, *Phosphorus, Sul-fur, and Silicon*, 182, 413 (2007).
- [12] I. Yavari, A. Ramazani, and A. Yahya-Zadeh, Synth. Commun., 26, 4495 (1996).
- [13] A. Ramazani, E. Ahmadi, A. R. Kazemizadeh, L. Dolatyari, N. Noshiranzadeh, I. Eskandari, and A. Souldozi, *Phosphorus, Sulphur, and Silicon*, 180, 2419 (2005).
- [14] A. Ramazani and M. Mohammadi-Vala, Phosphorus, Sulfur, and Silicon, 176, 223 (2001).
- [15] A. Ramazani, I. Amini, and A. Massoudi, *Phosphorus, Sulphur, and Silicon*, 181, 2225 (2006).
- [16] A. Ramazani, A. R. Kazemizadeh, E. Ahmadi, N. Noshiranzadeh, and A. Souldozi, *Curr. Org. Chem.*, **12**, 59 (2008).
- [17] G. Keglevich, Curr. Org. Chem., 6, 891 (2002).
- [18] G. Keglevich, H. Forintos, and T. Koertvelyesi, Curr. Org. Chem., 8, 1245 (2004).
- [19] A. Shaabani, E. Soleimani, H. R. Khavasi, R.-D. Hoffmann, U. Ch. Rodewald, and R. Pöttgen, *Tetrahedron Lett.*, 47, 5493 (2006).
- [20] A. Alizadeh, S. Rostamnia, and L.-G. Zhu, Tetrahedron, 62, 5641 (2006).
- [21] A. Shaabani, E. Soleimani, and A. Maleki, Tetrahedron Lett., 47, 3031 (2006).

- [22] A. Shaabani, M. B. Teimouri, and H. R. Bijanzadeh, Tetrahedron Lett., 43, 9151 (2002).
- [23] A. Shaabani, I. Yavari, M. B. Teimouri, A. Bazgir, and H. R. Bijanzadeh, *Tetrahe-dron*, 57, 1375 (2001).
- [24] J. Zhu and H. Bienaymé (Eds.), *Multicomponent Reactions* (Wiley-VCH, Weinheim, 2005).
- [25] A. Alizadeh, S. Rostamnia, and A. A. Esmaili, Synthesis, 709 (2007).
- [26] A. Alizadeh, S. Rostamnia, and M.-L. Hu, Synlett, 1592 (2006).
- [27] A. Souldozi, A. Ramazani, N. Bouslimani, and R. Welter, *Tetrahedron Lett.*, 48, 2617 (2007).
- [28] A. Souldozi and A. Ramazani, Tetrahedron Lett., 48, 1549 (2007).
- [29] A. Ramazani, A. Morsali, B. Ganjeie, A. R. Kazemizadeh, E. Ahmadi, R. Kempe, and I, Hertle, Z. Naturforsch., 60b, 569 (2005).
- [30] A. Ramazani, M. Kardan, and N. Noshiranzadeh, Synth. Commun., 38, 383 (2008).
- [31] N. Noshiranzadeh, A. Ramazani, A. Tofangchi Mahyari, K. 'Slepokura, and T. Lis, Z. Naturforsch., 63b, 65 (2008).
- [32] A. R. Kazemizadeh, E. Ahmadi, F. Marandi, and A. Ramazani, *Phosphorus, Sulfur, and Silicon*, 182, 2855 (2007).
- [33] A. Souldozi, K. 'Slepokura, T. Lis, and A. Ramazani, Z. Naturforsch., 62b, 835 (2007).
- [34] N. Noshiranzadeh and A. Ramazani, Phosphorus, Sulfur, and Silicon, 183, 144 (2008).
- [35] A. Tofangchi Mahyari, N. Shajari, A. R. Kazemizadeh, K. 'Slepokura, T. Lis, and A. Ramazani, Z. Naturforsch., 62b, 829 (2007).
- [36] B. Ganjeie, A. Ramazani, and A. R. Kazemizadeh, *Phosphorus, Sulfur, and Silicon*, 182, 1703 (2007).
- [37] N. Noshiranzadeh and A. Ramazani, Synth. Commun., 37, 3181 (2007).