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A mild and efficient method for the preparation of acyl azides from carboxylic acids using triphosgene

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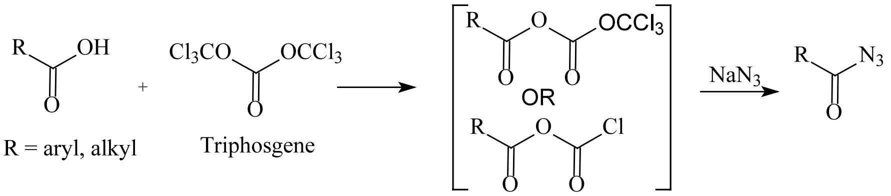
Abstract—An efficient use of triphosgene for the preparation of various acyl azides from carboxylic acids and sodium azide is described. © 2002 Elsevier Science Ltd. All rights reserved.

Over the last few years triphosgene [bis(trichloromethyl)carbonate] has emerged as a versatile synthetic auxiliary for the synthesis of some important classes of organic compounds.[1] This white crystalline compound has proved to be safe and advantageous in comparison with its gaseous congener, phosgene. In our recent communication[2] we have reported an efficient use of triphosgene as an acid activator in the construction of β-lactam rings by ketene–imine cycloaddition reactions. In this communication we wish to report the application of triphosgene as a reagent for the preparation of various acyl azides from carboxylic acids and sodium azide under very mild reaction conditions.

Acyl azides are valuable synthetic intermediates.[3] They are useful for the preparation of amides and they undergo facile thermal rearrangement to isocyanates. Various amines, urethanes and ureas can be easily obtained from isocyanates. Acyl azides are usually prepared from acid derivatives such as acid halides and acyl hydrazides.[3,4] The combinations of chromic anhydride–trimethylsilyl azide[5] and triazidochlorosilane-active manganese dioxide[6] have been reported for the preparation of acyl azides from aldehydes. There are a few reports on the direct conversion of carboxylic acids to acyl azides by using acid activators such as ethyl chloroformate,[7] diphenylphosphoryl azide (DDPA),[8] phenyldichlorophosphate,[9] $SOCl_2$–DMF[10] and NCS–triphenylphosphine.[11]

Triphosgene is known to react with acids to produce acid chlorides or anhydrides.[12] We have successfully employed this reagent for the direct conversion of acids to acyl azides (Scheme 1). Various aryl as well as alkyl carboxylic acids on reaction with triphosgene in the presence of sodium azide and triethylamine undergo smooth conversion to the corresponding acyl azides in very good yields (Table 1). This method was found to be very mild, efficient, and general as any acid could be easily converted to its acyl azide without a Curtius rearrangement leading to an isocyanate. The addition of triethylamine is essential as no acyl azide formation was observed in the absence of triethylamine.

Typical experimental procedure for the preparation of benzoyl azide: To a stirred solution of benzoic acid (0.61 g, 5 mmol) and sodium azide (0.65 g, 10 mmol) in



Scheme 1.

Keywords: acyl azides; carboxylic acids; sodium azide; triphosgene.

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Table 1. Preparation of acyl azides from carboxylic acids and sodium azide using triphosgene

Entry no.	Substrate	Product[a]	Yield[b] (%)	Mp (°C)[c]
1	Benzoic acid	Benzoyl azide	81	Oil
2	*p*-Toluic acid	*p*-Toluoyl azide	83	88–90
3	*o*-Toluic acid	*o*-Toluoyl azide	79	90–92
4	*p*-Nitrobenzoic acid	*p*-Nitrobenzoyl azide	55	68–69 (65–66)[9]
5	*o*-Chlorobenzoic acid	*o*-Chlorobenzoyl azide	59	62–64
6	Phenoxyacetic acid	Phenoxyacetyl azide	65	Oil
7	Phenylacetic acid	Phenylacetyl azide	85	86–88
8	Cinnamic acid	Cinnamoyl azide	72	82–84
9	3,5-Dinitrobenzoic acid	3,5-Dinitrobenzoyl azide	50	100–102 (104–105)[9]
10	Nonanoic acid	Nonanoyl azide	96	Oil
11	Octanoic acid	Octanoyl azide	94	Oil
12	Hexanoic acid	Hexanoyl azide	95	Oil

[a] All products were fully characterized by spectroscopic data (IR; ^{1}H NMR; MS) and elemental analyses.

[b] Isolated yield.

[c] Figures in parentheses show lit. mp.

acetone (20 ml) was added triethylamine (1.01 g, 10 mmol) at 0°C. The reaction mixture was stirred at this temperature for 15 min and a solution of triphosgene (0.74 g, 2.5 mmol) in acetone (10 ml) was added dropwise at 0°C over about 30 min. The reaction mixture was slowly allowed to warm up to room temperature and stirred for 24 h. The reaction mixture was filtered to remove insoluble salts and the filtrate was diluted with an equal volume of petroleum ether. This solution was passed through a short silica-gel column and the solvent was removed under reduced pressure at room temperature to give pure benzoyl azide (0.595 g, 81%).

In summary, we have demonstrated a general method for the preparation of acyl azides from acids using triphosgene as an activator.

References

1. Cotarca, L.; Delogu, P.; Nardelli, A.; Sunjic, V. *Synthesis* **1996**, 553–576.
2. Krishnaswamy, D.; Bhawal, B. M.; Deshmukh, A. R. A. S. *Tetrahedron Lett*. **2000**, *41*, 417–419.
3. (a) Patai, S. *The Chemistry of Azido Group*; Interscience: New York, 1971; pp. 397–405; (b) Lwowski, W. In *Azides Nitrenes*; Scriven, E. F. V., Ed.; Academic: Orlando, FL, 1984; pp. 205–246; (c) Moore, H. W.; Goldish, D. M. In *Chem. Halides Pseudo-Halides Azides*; Patai, S.; Rappoport, Z., Eds.; Wiley: Chichester, UK, 1983; Vol. 1, pp. 321–368.
4. Laszlo, P.; Polla, E. *Tetrahedron Lett*. **1984**, *25*, 3701–3704.
5. (a) Lee, J. G.; Kwak, K. H. *Tetrahedron Lett*. **1992**, *33*, 3165–3166; (b) Reddy, P. S.; Yadagiri, P.; Lumin, S.; Falck, J. R. *Synth. Commun*. **1988**, *18*, 545–551.
6. Elmorsy, S. S. *Tetrahedron Lett*. **1995**, *36*, 1341–1342.
7. (a) Kobyashi, S.; Kamiyama, K.; Iimori, T.; Ohno, M. *Tetrahedron Lett*. **1984**, *25*, 2557–2560; (b) Canone, P.; Akssira, M.; Dahouh, A.; Kasmi, H.; Boumzebrra, M. *Heterocycles* **1993**, *36*, 1305–1314.
8. Shao, H.; Colucci, M.; Tong, S.; Zhang, H.; Castelhano, A. L. *Tetrahedron Lett*. **1998**, *39*, 7235–7238.
9. Lago, J. M.; Arrieta, A.; Palomo, C. *Synth. Commun*. **1983**, *13*, 289–296.
10. Arrieta, A.; Aizpurua, J. M.; Palomo, C. *Tetrahedron Lett*. **1984**, *25*, 3365–3368.
11. Froeyen, P. *Phosphorous, Sulfur Silicon Relat. Elem*. **1994**, *89*, 57–61.
12. Kotz, R.; Roestemadji, J.; Mobashery, S. *J. Org. Chem*. **1994**, *59*, 2913–2914.