Organic Syntheses

A Publication
of Reliable Methods
for the Preparation
of Organic Compounds

Working with Hazardous Chemicals

The procedures in *Organic Syntheses* are intended for use only by persons with proper training in experimental organic chemistry. All hazardous materials should be handled using the standard procedures for work with chemicals described in references such as "Prudent Practices in the Laboratory" (The National Academies Press, Washington, D.C., 2011; the full text can be accessed free of charge at http://www.nap.edu/catalog.php?record_id=12654). All chemical waste should be disposed of in accordance with local regulations. For general guidelines for the management of chemical waste, see Chapter 8 of Prudent Practices.

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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

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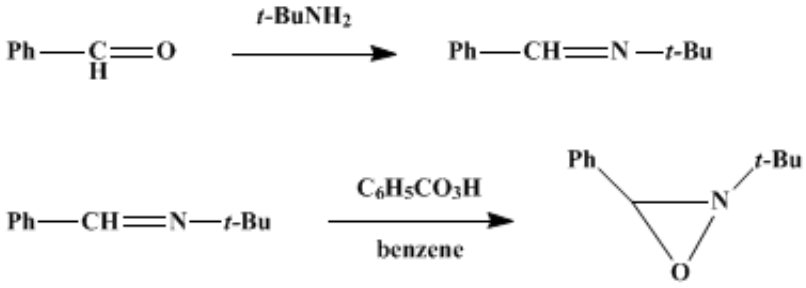
2-*t*-BUTYL-3-PHENYLOXAZIRANE

[Oxaziridine, 2-*t*-butyl-3-phenyl-]



Submitted by W. D. Emmons and A. S. Pagano[1].
Checked by G. Ryan and Ronald Breslow.

1. Procedure

Caution! Reactions and subsequent operations involving peracids and peroxy compounds should be run behind a safety shield. Peroxy compounds should be added to the organic material, never the reverse. For relatively fast reactions, the rate of addition of the peroxy compound should be slow enough so that it reacts rapidly and no significant unreacted excess is allowed to build up. The reaction mixture should be stirred efficiently while the peroxy compound is being added, and cooling should generally be provided since many reactions of peroxy compounds are exothermic. New or unfamiliar reactions, particularly those run at elevated temperatures, should be run first on a small scale. Reaction products should never be recovered from the final reaction mixture by distillation until all residual active oxygen compounds (including unreacted peroxy compounds) have been destroyed. Decomposition of active oxygen compounds may be accomplished by the procedure described in Korach, M.; Nielsen, D. R.; Rideout, W. H. Org. Synth. 1962, 42, 50 (Org. Synth. 1973, Coll. Vol. 5, 414). [Note added January 2011].

A. *N-t-butylbenzaldimine*. A 1-l. three-necked flask equipped with stirrer, thermometer, and condenser for downward distillation is charged with 109.5 g. (1.5 moles) of *t*-butylamine (Note 1). Benzaldehyde (106 g., 1.0 mole) is then added in four increments to the stirred solution over a 20-minute period. A mild exotherm is noted which raises the temperature to 40–50°. Benzene (150 ml.) is then added and the solution is heated until distillation commences. Solvent (a mixture of amine, water, and benzene) is removed by distillation until a pot temperature of 110° is reached. The product mixture is then cooled to room temperature, dried over magnesium sulfate, and stripped free of solvent at aspirator pressure. Distillation of the yellow liquid so obtained yields 120–151 g. (78–94%) of colorless N-*t*-butylbenzaldimine, b.p. 59–63° (1 mm.), n^{26}D 1.5174, n^{20}D (Note 2).

B. *2-t-Butyl-3-phenyloxazirane*. A 1-l. three-necked flask equipped with an addition funnel, stirrer, and condenser is charged with 68.0 g. (0.422 mole) of N-*t*-buylbenzaldimine (Note 3) and 50 ml. of benzene. The stirred solution is cooled in an ice bath and a solution of 61 g. (0.445 mole) of perbenzoic acid in 315 ml. of benzene is added dropwise over a 40-minute period. After one additional hour the stirrer is stopped, and the reaction mixture is allowed to stand overnight with the concurrent melting of the ice bath. The light blue benzene solution is then filtered to remove the precipitated benzoic acid and is washed sequentially with three 100-ml. portions of sodium carbonate, 100 ml. of 5% hydrochloric acid, 100 ml. of saturated sodium bisulfite solution, and finally with 100 ml. of water. The solution is dried over magnesium sulfate, and the solvent is evaporated at room temperature (Note 4) at aspirator pressure. There is obtained 46–60 g. (60–78%) of crude oxazirane, n^{26}D 1.5065. This product assays 96–

98% purity by iodimetric titration (Note 5) and is sufficiently pure for many purposes. Distillation of the crude product through a short Vigreux column yields, after a few drops of forerun, 42–55 g. (56–74%) of pure oxazirane, n^{26}D 1.5062, n^{20}D 1.5144, b.p. 55–58° (0.05 mm.), 74–76° (0.2 mm.). Iodimetric assay of this product indicates a purity of 99–100%.

2. Notes

1. Eastman Kodak white label reactants are satisfactory. The benzaldehyde should be freshly distilled before use.
2. The checkers handled and stored this material under nitrogen.
3. The charge of N-*t*-butylbenzaldimine is adjusted according to the amount of perbenzoic acid available. The perbenzoic acid in benzene is prepared by the procedure of Silbert, Siegel, and Swern,[2] and a 5% excess of this reagent is employed in the oxidation. In one attempt with commercial *m*-chloroperbenzoic acid instead, the checkers obtained only a 34% yield of oxazirane.
4. A rotary evaporator is very convenient for this operation.
5. A 0.200–0.300 g. sample of the oxazirane is weighed into a stoppered flask to which is added 15 ml. of glacial acetic acid and 2 ml. of saturated aqueous sodium iodide solution. After 5–10 minutes 25 ml. of deionized water is added, and the liberated iodine is titrated with 0.1*N* sodium thiosulfate with freshly prepared starch as indicator. Each milliliter of thiosulfate solution is equivalent to 0.00885 g. of 2-*t*-butyl-3-phenyloxazirane.

3. Discussion

This procedure is an adaptation of that described by Emmons for the preparation of oxaziranes from imines using peracetic acid.[3] Other procedures which may be more useful for oxazirane preparation in specific instances are the oxidation of imines with *m*-chloroperbenzoic acid[4] and the reaction of aldehydes or ketones with hydroxylamine *O*-sulfonic acid in alkaline solution.[5] 2-*t*-Butyl-3-phenyloxazirane has also been prepared by photolysis of α-phenyl-N-*t*-butylnitrone[6] (a general reaction of considerable theoretical interest since it represents direct conversion of electromagnetic energy to chemical energy) and in low yields by ozonolysis of N-*t*-butylbenzaldimine.[7]

Oxaziranes are in a real sense active oxygen compounds and exhibit many reactions grossly analogous to those of organic peroxides. Thus they undergo one electron transfer reaction with ferrous salts and on pyrolysis they are converted to amides. Oxaziranes are also useful synthetic intermediates since in appropriate cases they may be isomerized to aromatic nitrones which are a convenient source of N-alkylhydroxylamines.[3] The reaction of oxaziranes with peracids also provides a source of nitrosoalkanes and is in many instances the method of choice for preparation of these compounds.[8]

References and Notes

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2. L. S. Silbert, E. Siegel, and D. Swern, this volume, p. 904.
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7. A. H. Riebel, R. F. Erickson, C. J. Abshire, and P. S. Bailey, *J. Am. Chem. Soc.*, **82**, 1801 (1960).
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Appendix
Chemical Abstracts Nomenclature (Collective Index Number); (Registry Number)

hydrochloric acid (7647-01-0)

acetic acid (64-19-7)

Benzene (71-43-2)

sodium carbonate (497-19-8)

sodium thiosulfate (7772-98-7)

nitrogen (7727-37-9)

Benzoic acid (65-85-0)

sodium bisulfite (7631-90-5)

benzaldehyde (100-52-7)

iodine (7553-56-2)

sodium iodide (7681-82-5)

magnesium sulfate (7487-88-9)

peracetic acid (79-21-0)

hydroxylamine O-sulfonic acid (2950-43-8)

Perbenzoic acid (93-59-4)

Oxaziridine, 2-t-butyl-3-phenyl-,
2-t-butyl-3-phenyloxazirane (7731-34-2)

N-t-butylbenzaldimine (6852-58-0)

α-phenyl-N-t-butylnitrone

t-butylamine (75-64-9)

m-Chloroperbenzoic acid (937-14-4)