



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.

In some articles in *Organic Syntheses*, chemical-specific hazards are highlighted in red "Caution Notes" within a procedure. It is important to recognize that the absence of a caution note does not imply that no significant hazards are associated with the chemicals involved in that procedure. Prior to performing a reaction, a thorough risk assessment should be carried out that includes a review of the potential hazards associated with each chemical and experimental operation on the scale that is planned for the procedure. Guidelines for carrying out a risk assessment and for analyzing the hazards associated with chemicals can be found in Chapter 4 of Prudent Practices.

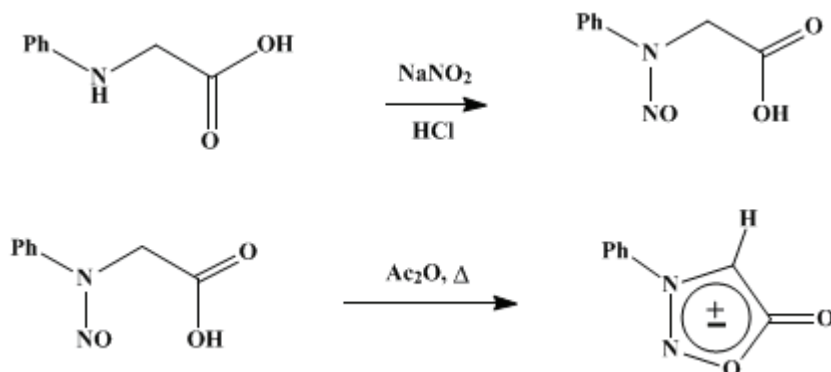
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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

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3-PHENYLSYDNONE

[N-Phenylsydnone]



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1. Procedure

A. *N-Nitroso-N-phenylglycine*. One hundred grams (0.66 mole) of *N*-phenylglycine (Note 1) is suspended in 1.2 l. of water contained in a 3-l. beaker placed in an ice-salt bath and stirred until the temperature has dropped below 0°. A solution of 50 g. (0.72 mole) of sodium nitrite in 300 ml. of water is added dropwise over a period of 40 minutes at such a rate that the temperature never exceeds 0°. The red, almost clear solution (Note 2) is filtered as quickly as possible with suction, after which 3 g. of Norit[®] is added and allowed to stir with the cold solution for several minutes (Note 3). The mixture is again filtered with suction. Addition of 100 ml. of concentrated hydrochloric acid to the well-stirred solution produces, after about 30 seconds, a profusion of light, fluffy crystals. The suspension is stirred for 10 minutes and is then filtered with suction and washed twice with ice-cold water. The precipitate is best dried by leaving it on the suction funnel overnight. The resulting product melts at 103–104°, weighs 96–99 g. (80–83%) (Note 4), and is off-white in color. It can be used without recrystallization.

B. *3-Phenylsydnone*. The 99 g. (0.55 mole) of *N*-nitroso-*N*-phenylglycine is dissolved in 500 ml. of acetic anhydride in a 1-l. Erlenmeyer flask fitted with a reflux condenser topped by a drying tube. The deep-red solution is heated in a boiling water bath for 1.5 hours with magnetic stirring (Note 5) and is then allowed to cool to room temperature. The cool solution is poured slowly into 3 l. of cold water which is very well stirred (Note 6), white crystals separate almost immediately. After 5 minutes of stirring, the solid is filtered with suction, washed twice with ice-cold water, and dried on the funnel with suction overnight. The dried product is cream-colored, weighs 74–75 g. (83–84%), and melts at 136–137° (Note 7). The overall yield for the two steps is 67–70%.

2. Notes

1. Eastman Organic Chemicals practical grade material, mud-brown in color, was used without purification.
2. Often a small amount of insoluble, dark-brown material remains in suspension. Filtration of this product is most difficult, since it tends to clog the filter paper. It seems advisable to change filter papers two or three times during the filtration, if necessary. This step usually requires from 30 minutes to 1.5 hours; however, the time can be shortened appreciably by the use of Hyflo Supercel[®].
3. This Norit[®] treatment, when combined with the preceding filtration, does much to improve the purity of the *N*-nitroso-*N*-phenylglycine; though the yield of nitroso compound thereby is lowered, the yield of the sydnone is increased correspondingly and the sydnone is much purer.
4. Earl and Mackney² report a tan product (96.8% yield) melting at 102–103°. They did not use the

preliminary filtration or Norit® treatment described above.

5. The usual method (Earl and Mackney²) has been to let the solution stand at room temperature for 24 hours. Control experiments proved, however, that the procedure described above gives comparable results.³

6. On rare occasions a small amount of insoluble material may be present in the cool solution; the solution can be poured into the water through a funnel fitted with a plug of glass wool.

7. Earl and Mackney² report a very light tan product, melting at 134–135°, in 73% yield. The product can be recrystallized from boiling water to give cream-colored needles, but this does not improve the purity of the product.

3. Discussion

This procedure is a modification of preparations of 3-phenylsydnone described earlier.^{2,3} The dehydration of N-nitroso-N-phenylglycine has also been effected by the use of thionyl chloride and pyridine in dioxane,⁴ thionyl chloride in ether,⁴ trifluoroacetic anhydride in ether,⁴ and diisopropylcarbodiimide in water;⁵ or by reaction of the alkali metal salts of N-nitroso-N-phenylglycine with phosgene or benzenesulfonyl chloride in water⁵ or with acetyl chloride in benzene.⁴

4. Merits of the Preparation

The present procedure makes possible the preparation of large quantities of very pure 3-phenylsydnone without recrystallization. The earlier procedure² produced a tan or brown product which lost its color only after several recrystallizations. Slight variations in this procedure can be used to prepare a variety of 3-substituted and 3,4-disubstituted sydnone.

3-Phenylsydnone is the prototype of that class of mesoionic compounds called sydnone. On acidic hydrolysis it produces phenylhydrazine, whereas basic hydrolysis regenerates N-nitroso-N-phenylglycine. This sydnone undergoes a variety of electrophilic substitutions,^{3,4,6,7,8,9,10,11,12,13,14,15,16,17,18,19} including mercuration^{11,13,16} and formylation,¹⁹ with an ease comparable to thiophene, and a number of "1,3-dipolar cycloadditions" with numerous alkenes,^{15,18} alkynes,¹⁷ and quinones⁸ to form, with loss of carbon dioxide, a variety of pyrazole derivatives.

References and Notes

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Appendix
Chemical Abstracts Nomenclature (Collective Index Number);
(Registry Number)

hydrochloric acid (7647-01-0)

Benzene (71-43-2)

ether (60-29-7)

acetic anhydride (108-24-7)

acetyl chloride (75-36-5)

thionyl chloride (7719-09-7)

sodium nitrite (7632-00-0)

Phenylhydrazine (100-63-0)

carbon dioxide (124-38-9)

Norit (7782-42-5)

Benzenesulfonyl chloride (98-09-9)

pyridine (110-86-1)

phosgene (75-44-5)

Thiophene (110-02-1)

dioxane (123-91-1)

N-Nitroso-N-phenylglycine (6415-68-5)

N-phenylglycine (103-01-5)

diisopropylcarbodiimide (693-13-0)

trifluoroacetic anhydride (407-25-0)

3-Phenylsydnone,
N-Phenylsydnone (120-06-9)

