



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.

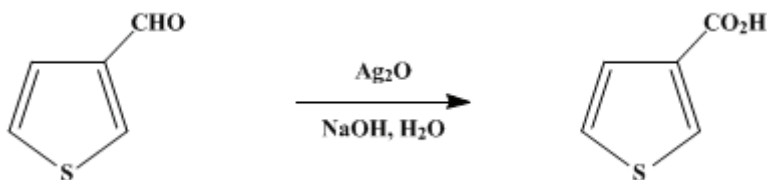
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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

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3-THENOIC ACID

[3-Thiophenecarboxylic acid]



Submitted by E. Campaigne and William M. LeSuer¹.
Checked by Charles C. Price and E. A. Dudley.

1. Procedure

Silver oxide is prepared by adding a solution of 150 g. (0.88 mole) of silver nitrate in 300 ml. of water to a solution of 70 g. (1.75 moles) of sodium hydroxide in 300 ml. of water. Continuous shaking during the addition ensures complete reaction and results in a brown semisolid mixture. To this mixture, contained in a 1-l. flask which is cooled in an ice bath, is added 47.5 g. (0.425 mole) of 3-thiophenecarbaldehyde (p. 918) in small portions with stirring. The oxidation is complete in about 5 minutes after the last of the aldehyde has been added. The black silver suspension is removed by suction filtration (Note 1) and is washed with several portions of hot water. The cold combined filtrate and washings are acidified with concentrated hydrochloric acid, precipitating 49 g. of 3-thiophenecarboxylic acid, which melts at 136–137°. Concentration of the mother liquors gives another 3–4 g. of acid, making a total of 52–53 g. (95–97%). Recrystallization of this acid from water raises the melting point to 137–138°.

2. Notes

1. This silver dissolves readily in concentrated nitric acid and may be used over and over in oxidations.

3. Discussion

3-Thiophenecarboxylic acid has been prepared in low yield by oxidation of 3-methylthiophene with potassium permanganate,^{2,3,4} dilute nitric acid, chromic acid, and hydrogen peroxide,⁴ and by reductive dechlorination of chloro-3-thiophenecarboxylic acid.⁴ Starting with 3-iodothiophene, which is difficult to obtain, good yields are obtained by the Grignard procedure⁵ or with cuprous cyanide and potassium cyanide in a sealed tube.⁶ 3-Thiophenecarboxylic acid has been made also from 3-bromothiophene by reaction with cuprous cyanide in quinoline, followed by hydrolysis,⁷ and by carbonation of the Grignard reagent from 3-bromothiophene which is prepared by entrainment with ethyl bromide.⁸

Oxidation of the aldehyde was not used earlier because of the difficulty of obtaining the aldehyde, which is now readily available by the Sommelet synthesis from 3-thiophenyl bromide. Campaigne and LeSuer⁹ also used alkaline permanganate as the oxidizing agent, but the yields decreased to 40–60%. The present procedure gives an over-all yield from 3-methylthiophene of about 45%.

References and Notes

1. Indiana University, Bloomington, Indiana.
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4. Voerman, *Rec. trav. chim.*, **26**, 293 (1907).
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6. Rinke, *Rec. trav. chim.*, **55**, 991 (1936).

7. Nishimura, Motoyama, and Imoto, *Bull. Univ. Osaka Prefect., Ser. A*, **6**, 127 (1958) [*C. A.*, **53**, 4248 (1959)].
 8. Gronowitz, *Arkiv Kemi*, **7**, 267 (1954).
 9. Campaigne and LeSuer, *J. Am. Chem. Soc.*, **70**, 1555 (1948).
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Appendix
Chemical Abstracts Nomenclature (Collective Index Number);
(Registry Number)

hydrochloric acid (7647-01-0)

sodium hydroxide (1310-73-2)

nitric acid (7697-37-2)

potassium permanganate (7722-64-7)

silver oxide (20667-12-3)

silver nitrate (7761-88-8)

Ethyl bromide (74-96-4)

Cuprous Cyanide (544-92-3)

potassium cyanide (151-50-8)

chromic acid (7738-94-5)

hydrogen peroxide (7722-84-1)

Quinoline (91-22-5)

silver (7440-22-4)

3-Methylthiophene (616-44-4)

3-Thenaldehyde

3-Thenyl bromide

3-Thenoic acid

3-Bromothiophene (872-31-1)

3-Thiophenecarboxylic acid (88-13-1)

chloro-3-thenoic acid

3-iodothiophene (10486-61-0)

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