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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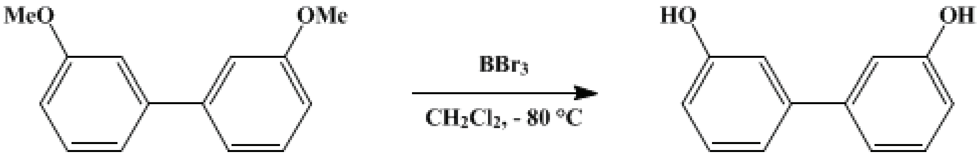
3,3'-DIHYDROXYBIPHENYL

[m,m'-Biphenol]



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Checked by J. E. Hiatt and K. B. Wiberg.

1. Procedure

3,3'-Dimethoxybiphenyl[2] (8 g., 0.037 mole) is dissolved in 120 ml. of methylene chloride in a 250-ml. conical flask, and the flask is placed in an acetone-dry ice bath at −80°. The flask is fitted with an air condenser. A solution of 15.9 g. (6.0 ml., 0.063 mole) of boron tribromide (Note 1), (Note 2) in 40 ml. of methylene chloride (Note 3), (Note 4) is added carefully to the stirred solution through the condenser. When the addition is complete, a calcium chloride tube is fitted to the top of the air condenser in order to protect the reaction mixture from moisture. As the solution of boron tribromide is added, a white precipitate is formed. The reaction mixture is allowed to attain room temperature overnight with stirring, when a clear, brownish yellow solution is obtained. The reaction mixture is then hydrolyzed by careful shaking with 130 ml. of water, thus precipitating a white solid which is dissolved by the addition of 500 ml. of ether. The organic layer is separated and extracted with 240 ml. of 2*N* sodium hydroxide; the alkaline extract is neutralized with dilute hydrochloric acid, extracted with 300 ml. of ether, and the ether extract is dried over anhydrous magnesium sulfate. On removal of the ether under reduced pressure, a brownish yellow oil remains which soon crystallizes to give an off-white solid; this is recrystallized twice from hot benzene, the first time with the addition of charcoal, and gives 3,3'-dihydroxybiphenyl as white needles with a pinkish tint, m.p. 126–127° (Note 5). The yield is 5.4–6.0 g. (77–86%).

2. Notes

1. Boron tribromide of 99.9% purity, from Koch-Light Laboratories Ltd., Colnbrook, Bucks, England, was used.
2. Boron tribromide is a heavy, colorless liquid (*d* = 2.6) when pure but begins to decompose on exposure to light, liberating free bromine. It fumes vigorously in air, being rapidly hydrolyzed to boric acid, with the evolution of considerable heat.
3. Demethylation reactions proceed equally well using dry *n*-pentane or dry methylene chloride as the solvent for both the ether and the boron tribromide; methylene chloride, having by far the more powerful solvent action, is to be preferred.
4. When making up the solution of boron tribromide in methylene chloride, it has been found best to stand the vessel containing the solvent in an acetone-dry ice bath at −80° and to add the required amount (it is difficult to measure accurately) to the methylene chloride as rapidly as possible.
5. In order to obtain a perfectly white product, recrystallization from water is necessary;[3,4] prismatic needles several centimeters long are obtained. The compound is moderately soluble in boiling water and slightly soluble in cold water.

3. Discussion

The above preparation of 3,3'-dihydroxybiphenyl is a good example of the utility of boron tribromide for the cleavage of aryl methyl ethers; it is based on the method of McOmie, Watts, and West.[5] 3,3'-Dihydroxybiphenyl has been prepared previously by diazotization[3] of 3,3'-diaminobiphenyl and subsequent boiling with water, by the fusion of biphenyl-3,3'-disulfonic acid with potassium hydroxide,[6] and by heating 3,3'-dimethoxybiphenyl with hydriodic acid.[4]

Almost all the methods previously employed[7] for the demethylation of aromatic methyl ethers have involved fairly high temperatures, *e.g.*, hydrogen halides in water or acetic acid at reflux temperature, whereas the present method is effective at, or well below, room temperature although in a few cases it has been found necessary to boil the solution (b.p. of methylene chloride, 40°). Boron tribromide does not effect cleavage of methylenedioxy groups nor of diphenyl ethers. It can be used for the demethylation of aryl methyl ethers in the presence of many functional groups without affecting these.[5] It is especially valuable for the demethylation of iodinated ethers[5] and of methoxy biphenylenes[8] where the usual reagents are either ineffective or else cause decomposition. Boron tribromide was the reagent of choice for the final (demethylation) step in the synthesis of the naturally occurring macrolide, Zearalenone.[9]

References and Notes

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

m,m'-Biphenol

hydrochloric acid (7647-01-0)

acetic acid (64-19-7)

Benzene (71-43-2)

ether (60-29-7)

sodium hydroxide (1310-73-2)

bromine (7726-95-6)

potassium hydroxide (1310-58-3)

hydriodic acid (10034-85-2)

n-PENTANE (109-66-0)

methylene chloride (75-09-2)

boric acid (10043-35-3)

magnesium sulfate (7487-88-9)

boron tribromide (10294-33-4)

3,3'-DIMETHOXYBIPHENYL (6161-50-8)

3,3'-dihydroxybiphenyl (612-76-0)

3,3'-diaminobiphenyl

biphenyl-3,3'-disulfonic acid