

Note

Microwave thermolysis: Part IX- A rapid reduction of sulphoxides With NaH_2PO_2 in dry media

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Reduction of a variety of sulphoxides using sodium hypophosphite under microwave irradiation is described. The method avoids the use of solvent and applicable for the variety of substrates.

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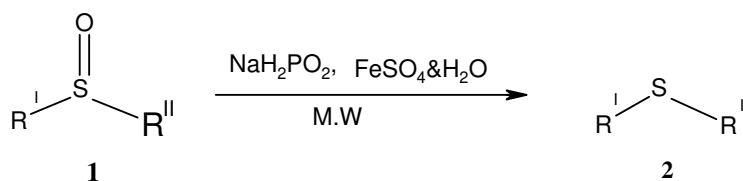
Reduction of sulphoxide is an important transformation in organic chemistry because sulphoxides are used as an intermediate in complex natural product synthesis and in stereoselective chiral induction and finally it is reduced or eliminated¹. There are various reagents² for this transformation. Among these phosphorus compounds^{2j} have made a major contributions because of their more affinity towards oxygen. Though these methods are satisfactory, often performed in solvents, which encounter the problem of product isolation, longer reaction time and environmental pollution associated with solvent. Recently, microwave assisted reactions³ have gained wide popularity because of reaction rate enhancement, operational simplicity and solvent free condition. Inspired by the need for "green processes"⁴ and our involvement⁵ in microwave reactions, we thought of performing reduction of sulphoxides in dry media. Sodium hypophosphite is used as a mild and efficient hydrogen transfer reagent⁶ in solid hetero-

geneous state in combination with Pd-C. Earlier Sauer *et al.*⁷ have reported selective efficiency of NaH_2PO_2 towards nitro arenes in solvent free condition. In this note we wish to report the deoxygenation of sulphoxides using NaH_2PO_2 in combination with FeSO_4 in dry media under microwave irradiation (**Scheme I**).

The initial reaction attempted in solvents like toluene, THF, and DMF did not show sulphoxide reduction even with higher ratio (1:7) and at longer reaction time (80°C, 10 hr) but in microwave irradiation, reaction completed with 1:3 ratio. We have examined various solid supports such as alumina, silica gel, and clay and found that alumina is suitable for this conversion. After completion of reaction the products were isolated by extraction. The importance of the method is demonstrated by the reduction of dibenzyl sulphoxide (Entry **h**) to thioether in moderate yield (**Table I**). Unlike other methods, the present protocol avoids the problem associated with halogenated reagents.

The remarkable feature of the procedure is that presence of halogen and double bond remain unaffected. This may be because of the synergist effect of FeSO_4 (ref. 8). The naphthylalkyl sulphoxide (entry **i, j, k, m**) were reduced to respective sulphides using 50% power (**Table I**). However, the reduction with 60% power and longer time gives 2-mercaptanaphthol as the major product. Further it is observed that naphthylaryl sulphoxide is reduced to sulphide without any side products. Further examination of bicyclic heterosystem (entry **l**) requires full power with longer reaction time. This may be because of ring nitrogen and strongly electron withdrawing trifluoromethyl group.

In conclusion, NaH_2PO_2 under microwave irradiation adds a rapid procedure to the existing methodologies for the reduction of sulphoxides. The



$\text{R}', \text{R}'' = \text{aryl, alkyl}$

Scheme I

Table I— Reduction of sulphoxides using sodium hypophphite

Entry	Substrate 1	Time (sec)	Yield (%)	Product ^{a,b} 2
a	$C_6H_5-SO-CH_3$	240	82	$C_6H_5-S-CH_3$
b	$C_6H_5-SO-CH_2CH_3$	240	80	$C_6H_5-S-CH_2CH_3$
c	$C_6H_5-SO-(CH_2)_4CH_3$	240	80	$C_6H_5-S-(CH_2)_4CH_3$
d	$C_6H_5-SO-CH=CH_2$	240	70	$C_6H_5-S-CH=CH_2$
e	$CH_3(CH_2)_4-SO-(CH_2)_{11}-CH_3$	240	72	$CH_3(CH_2)_4-S-(CH_2)_{11}-CH_3$
f		240	60	
g		300	65 ^c	
h		280	69 ^c	
i		240	76 ^d	
j		240	72 ^d	
k		240	85 ^d	
l		300	76	
m		240	70 ^c	
n		260	60 ^{b,c}	

a) Refers to pure product after column chromatography.

b) All products are characterized by m.p/b.p and ¹H NMR.

c) Reaction remains incomplete and starting material recovered.

d) MW oven operated at power 50%

method avoids the use of dry solvents, expensive Pd-C catalyst and applicable to a variety of substrates.

Experimental Section

Boiling points and melting points are uncorrected. Melting points were recorded on Buchi R535 apparatus. IR spectra were recorded on a IR Nicole 740 FT-IR spectrometer; ^1H NMR spectra on a FT (200 Gemini) spectrometer; and mass spectra on either Micro mass 7070 h or Finnigan Mat 1020 B mass spectrometer operating at 70 eV. Thin layer chromatography was done on precoated silica gel 60f 254 (0.5 mm) glass plates.

General procedure

The reduction of phenyl methyl sulphoxide is the representative of the general procedure employed. Neutral alumina (600 mg) was added to a dichloromethane solution of phenyl methyl sulphoxide (140 mg, 1 mmole). After evaporation of solvent, the dry powder was mixed with NaH_2PO_2 (295mg, 3mmoles) and ferrous sulphate (278 mg, 1mmole) in a mortar and pestle. The mixture was transferred into a test tube and subjected to interrupted (60 sec each time) microwave irradiation (240 sec) at low power of 60% (BPL make BMO 700T, 650W, operating at frequency of 2450 MHZ). After completion of the reaction the product was extracted with dichloromethane (3×20 mL). The solvent was removed under reduced pressure and the crude product was purified by column chromatography using hexane-ethyl acetate (95:5) as eluent. The pure product (82%) was confirmed by NMR.

Caution: Sodium hypophosphite has a potential to generate free hydrogen, which is flammable and catches fire at elevated temperature. We suggest that the microwave oven be operated at 50-60% power with interrupted reaction time period (1 min each) because of the possible higher localized temperature.

Spectral data

2g: mp 44 - 46°C; ^1H NMR (200MHz, CDCl_3): δ 7.15–7.31 (m, 10H), 3.54 (s, 4H).

2k: mp 16-17°C (bp¹⁵ 170°C); ^1H NMR (200MHz, CDCl_3): δ 7.79–7.62 (m, 4H), 7.41-7.30 (m, 3H), 2.98 (s, 3H).

2l: mp 98-100°C; ^1H NMR (200MHz, CDCl_3): δ 8.4 (d, 1H), 8.1(d, 1H), 7.6 (t, 1H), 7.4 (d, 2H), 7.3 (d, 2H), 7.0 (s, 1H), 2.4 (s, 3H).

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