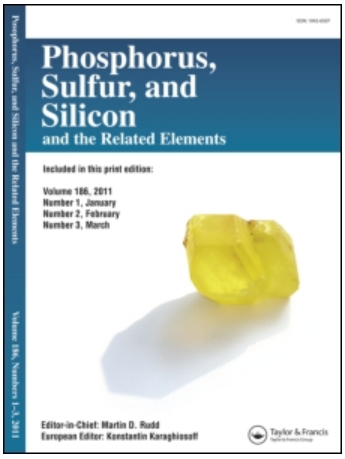


Phosphorus, Sulfur, and Silicon and the Related Elements
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713618290

Reduction with Sulfur Dioxide

Wolfgang Bauer[a]
[a] Cassella AG, Frankfurt/Main

To cite this Article Bauer, Wolfgang(1994) 'Reduction with Sulfur Dioxide', Phosphorus, Sulfur, and Silicon and the Related Elements, 95: 1, 493 — 494
To link to this Article: DOI: 10.1080/10426509408034289
URL: http://dx.doi.org/10.1080/10426509408034289

Phosphorus, Sulfur, and Silicon, 1994, Vol. 95-96, pp. 493-494
Reprints available directly from the publisher
Photocopying permitted by license only

REDUCTION WITH SULFUR DIOXIDE

WOLFGANG BAUER
Cassella AG, D-60343 Frankfurt/Main

Abstract A general method to reduce arene sulfonylchlorides to diarene disulfanes has been developped using sulfur dioxide and hydroiodic acid/quarternary ammonium salts as catalysts in a two - phase system.

INTRODUCTION

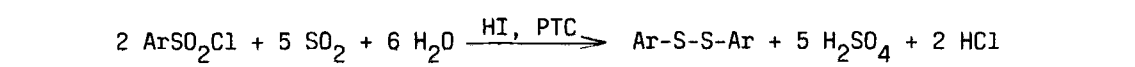
Zinc effectively converts arene sulfonylchlorides into arene thiols[1] which are industrially used as starting materials for the production of thioindigo dyes.

$$ArSO_2Cl + 3\ H_2SO_4 + 3\ Zn \longrightarrow ArSH + 3\ ZnSO_4 + HCl + 2\ H_2O$$

However, environmental problems arise from the separation and disposal of zinc salts formed since more than 500 kg of zinc sulfate per kmole arene sulfonylchloride have to be disposed of. Known metal-free procedures for the reduction of arene sulfonylchlorides include the use of hydroiodic acid[2,3] and sodium hydrogensulfite in the presence of hydroiodic acid (20 - 50 mole%)[4].

RESULTS AND DISCUSSION

For cost reasons sulfur dioxide and hydroiodic acid in catalytic amounts (1 - 5 mole%) have been used. As depicted in Table 1 unsatisfying yields of diarene disulfanes are obtained due to competing hydrolysis to arene sulfonic acids. However, addition of catalytic amounts of quarternary ammonium salts as co - catalysts results in a drastic increase in the yields of diarene disulfanes[5].



$$2\ ArSO_2Cl + 5\ SO_2 + 6\ H_2O \xrightarrow{HI,\ PTC} Ar\text{-}S\text{-}S\text{-}Ar + 5\ H_2SO_4 + 2\ HCl$$

TABLE 1 Sulfur dioxide reduction of arene sulfonylchlorides with HI-and phase transfer catalysis

Arene sulfonylchloride	mole%HI	mole% $R_3\overset{+}{N}CH_3\ Cl^-$	yield diarene disulfane
2,5-Dichlorobenzene	2	-	77 %
sulfonylchloride	2	1	97 %
4-Chloro-2,5-dimethyl benzene	5	-	-
sulfonylchloride	5	2	93 %
2,4-Dichloro-5-methyl benzene	2	-	60 %
sulfonylchloride	2	1	93 %
Naphthalene-2-	2	-	55 %
sulfonylchloride	2	1	90 %
8-Chloronaphthalene-	2	-	50 %
1-sulfonylchloride	2	1	96 %

* $R = C_8H_{17}$

The principle of sulfur dioxide reduction with hydroiodic acid catalysis can be applied to copper phthalocyanine tetrasulfonylchloride to give a green pigment - like disulfane which is then reduced with sodium hydrogensulfide to produce a water - soluble green sulfur dye[6].

The observed catalytic effect can be explained by an extraction of hydroiodic acid by quarternary ammonium salts into the organic phase which consists of inert solvents like toluene or chlorobenzene. Formed iodine is reconverted to hydroiodic acid:

Catalytical principle: $I_2 \underset{\longleftarrow}{\overset{SO_2,\ H^{\oplus}}{\longrightarrow}} 2\ HI$, HI-extraction

REFERENCES

1. K.D.Gundermann, K.Hümke, in Houben-Weyl,Methoden der Organischen Chemie (G.Thieme Verlag, Stuttgart, 1985), Vol. E 11, p. 52.
2. H.Muth, M.Sauerbier,in Houben-Weyl,Methoden der Organischen Chemie (G.Thieme Verlag, Stuttgart, 1980), Vol. IV/1 c, p. 566, 575.
3. L.Bauer, J.Cymermann, J.Chem.Soc., 1949, 3434.
4. USP 2 571 740 (1951), American Cyanamide Co. (H.W.Marson)
5. EP 93 363 (1983), Cassella AG (W.Bauer, K.Kühlein)
6. EP 93 362 (1983), Cassella AG (W.Bauer, K.Kühlein, G.Nagl)