Selective oxidation of thiols to disulfides is one of the widely studied transformations in organic chemistry as the disulfide moiety frequently occurs in proteins and bioactive natural products. Moreover, thiols can be conveniently protected as disulfides and be regenerated by cleavage of the S-S bond. Disulfides have found numerous applications in industry as vulcanizing agents for rubber and elastomers, imparting them excellent tensile strength. Also, these substrates due to the benefits of enhanced reaction rates, improved yields, cleaner reaction profiles and operational simplicity. KF-Al2O3 is one such versatile solid supported reagent and it has been used for a number of organic reactions and offered several advantages over classic bases. As a part of our program related to development of environmentally benign synthetic methodology, herein we wish to report our results, which constitute a mild and convenient method for the preparation of symmetrical disulfides from thiols using KF-Al2O3 as a catalyst.

Results and Discussion

The experimental procedure is simple. The reaction can be carried out simply by stirring an acetonitrile solution of the thiol with KF-Al2O3 at room temperature for 20-30 min, followed by isolation of the product by filtration, evaporation on a rotavap evaporator and purification by silica gel column chromatography (Scheme I). The generality of the method was elaborated to aliphatic, aromatic and hetero aromatic thiols. A variety of thiols were selectively oxidized to their corresponding disulfides in good yields without any evidence for the formation of the over oxidized products of their corresponding disulfide S-oxides (thiol sulfonates), disulfide S-dioxides (thiolsulfonates), and/or sulfonic acids under the reaction conditions.

Among the aliphatic thiols the reactivity was found to slightly decrease with increasing carbon chain length. Under identical reaction conditions aliphatic thiols and aromatic thiols have shown almost similar reactivity. Pertinent results are summarized in Table I.

In the present report, we have shown that KF-Al2O3 is an efficient, rapid, mild and inexpensive reagent for the synthesis of aliphatic, aromatic and hetero aromatic disulfides.

Experimental Section

All the products are known compounds and were checked by comparison of their spectral and physical properties.

KF-Al2O3 catalyzed mild and efficient preparation of symmetrical disulfides from thiols

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A facile, efficient, convenient and environmentally friendly method for the oxidation of various thiols to their corresponding disulfides catalyzed by KF-Al2O3 in very short reaction times in acetonitrile and at room temperature has been reported.

Keywords: Potassium fluoride-alumina, oxidation, thiols, disulfides

Note

**Scheme I**

2 R-SH → R-S-S-R

CH₃CN; 20-30 min
properties with an authentic sample. KF-Al₂O₃ was prepared by a reported procedure⁶⁹.

**Oxidation of Thiols**

**General Procedure**

To a mixture of 11-mercapto undecene-1-ol (0.5 g; 2.4 mmol) in acetonitrile (6 mL), KF-Al₂O₃ (1 g) was added and the reaction mixture was stirred at RT for 24 min. After completion of the reaction (monitored by TLC), the KF-Al₂O₃ was filtered off. Evaporation of the solvent under reduced pressure followed by chromatography over silica gel using light petroleum-ethyl acetate as eluent furnished the corresponding pure disulfide in 70–82% yield.

### Table I — Oxidative coupling of various thiols

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<th>Time (min)</th>
<th>Yield (%) a</th>
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</table>

a Yields are based on isolated products.
b All products were known compounds and identified by comparison of their physical and spectroscopic data with those of authentic samples.

**Conclusion**

In summary, the use of KF-Al₂O₃ for oxidation of thiols has numerous advantages. The use of KF-Al₂O₃ provides a remarkably simple, mild, very rapid, selective, general and practical procedure for the high-yielding preparation of a variety of disulfides. KF-Al₂O₃ is an excellent, cheap and environmentally friendly solid supported reagent; therefore it is superior to various other reagents reported for the oxidation of thiols.

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References


