

# SYNLETT Spotlight 71

This feature focuses on a reagent chosen by a postgraduate, highlighting the uses and preparation of the reagent in current research

## Trimethylsilyl Trifluoromethanesulfonate (TMSOTf)

Compiled by William R. F. Goundry

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### Introduction

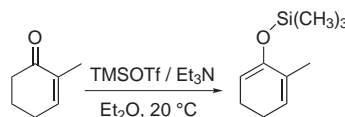
The title compound is a colourless, mobile liquid, which dissolves in aliphatic or aromatic hydrocarbons and haloalkanes without any reaction.<sup>1</sup> Due to the presence of the electron-withdrawing trifluoromethanesulfonyl moiety the silicon atom is extremely electron deficient. Subsequently the silicon atom reacts with heteroatoms, especially oxygen to form onium ions. In contrast to more conventional Lewis acids such as  $\text{AlCl}_3$  and  $\text{TiCl}_4$ , TMSOTf tends to bind to a single hetero functional group. TMSOTf is  $6.7 \times 10^8$  times more reactive than  $\text{TMSCl}$ , and this is manifested in an extreme sensitivity towards

moisture which must be excluded from all reactions.<sup>2</sup> The ability of TMSOTf to form supercationic species with organic substrates results in its utilization in a wide range of synthetic applications.<sup>3</sup>

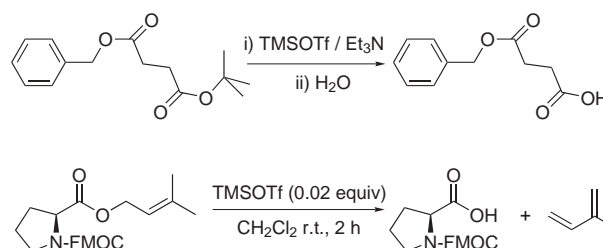
TMSOTf,<sup>4</sup> is prepared by the gradual addition of chlorotrimethylsilane to trifluoromethanesulfonic acid with stirring and protection from moisture. The mixture is heated until hydrogen chloride evolution ceases and then the product is isolated by fractional distillation. TMSOTf is also commercially available.

### Abstract

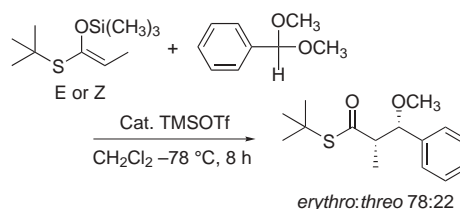
(A) Reaction with aldehydes and ketones gives quantitative yields of the trimethylsilyl enol ethers.<sup>5</sup> Triethylamine is often used as an auxiliary base, which produces an insoluble precipitate of triethylammonium triflate in non-polar solvents.<sup>6</sup>



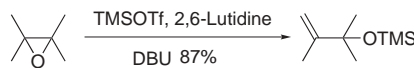
(B) *tert*-Butyl esters can easily be cleaved using TMSOTf to afford, after an aqueous work-up, the free carboxylic acid. Benzyl esters are not attacked under these conditions so selective deprotection of dicarboxylic acids can be achieved.<sup>7</sup> Recently Nishizawa et al. reported that a prenyl (3-methylbut-2-enyl) ester is catalytically cleaved by TMSOTf to give a carboxylic acid and isoprene with high chemoselectivity and without causing epimerization of a neighboring chiral center.<sup>8</sup>



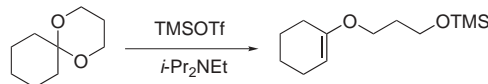
(C) A significant contribution to the methodology of TMSOTf was made by Noyori et al., who found that TMSOTf, with or without hindered tertiary amines, catalyses directed condensation of enol trimethylsilyl ethers with acetals.<sup>9</sup> The reaction of enol silyl ethers and carboxonium triflate ion-pair intermediates occurs via acyclic transition states and exhibits moderate to high *erythro*-selectivity independent of the geometry (*E/Z*) of the enol silyl ethers.



(D) TMSOTf when used in equimolar amounts with DBU can affect the ring opening of epoxides to allylic alcohols.<sup>10</sup> The very mild reaction conditions are applicable to cyclic substrates as well as 2,2-di, tri, and tetrasubstituted epoxides.



(E) The treatment of acetals of enolisable ketones and aldehydes with TMSOTf and *N,N*-diisopropylethylamine gives enol ethers in high yield.<sup>11</sup> In the case of cyclic acetals this gives a product retaining the TMS group.



## References

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