

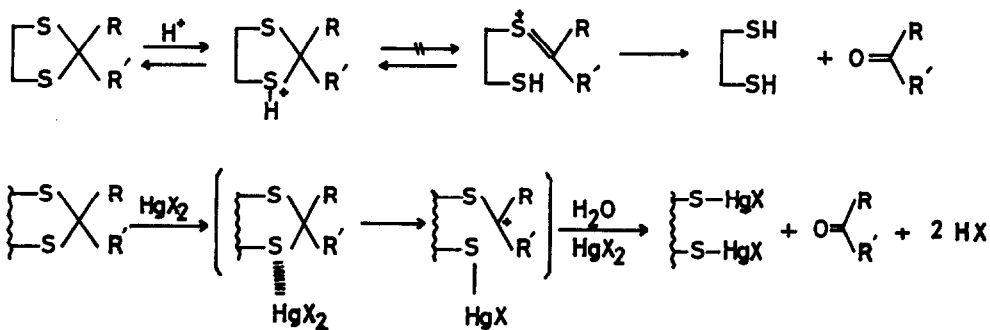
A NOVEL CLEAVAGE OF THIOKETETALS THROUGH THE ALKYLATION BY $\text{Et}_3\text{O}^+\text{BF}_4^-$ ¹⁾

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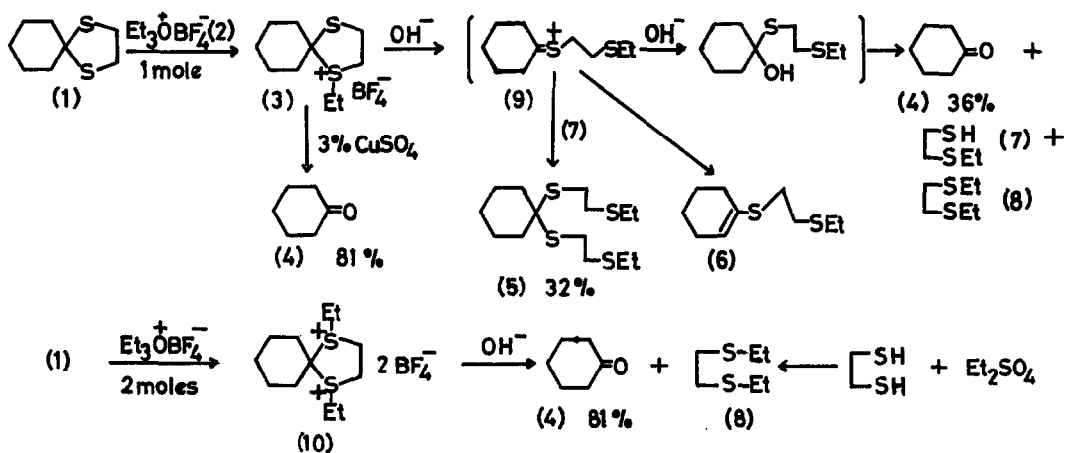
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The method of protecting ketones and aldehydes by the conversion to the corresponding thioketals has been rarely utilized in practice since thioketals resist to both acid and base catalysed hydrolysis. The significant characteristics of sulfur in divalent sulfides that the affinity to protic acids is weak and the electron-releasing conjugative effect is much less than that of oxygen²⁾ would account for this stable nature of thioketals. On the other hand, the sulfide sulfur which is highly polarizable, of low electronegativity, easily oxidized, and associated with empty low-lying orbitals is defined as soft base³⁾ and thus expected to combine more easily with softer reagents such as mercuric salts or alkylating reagents. In fact, mercuric salts have been employed to facilitate the hydrolysis of thioketals⁴⁾.



Recently, Corey and Seebach⁵⁾ have developed the new synthetic method utilizing the carbanion stabilized by a participation of 3d-orbital of the adjacent sulfur atoms⁶⁾. The products obtained by this method should contain thioketal moiety in principle. In connection with their work, the development of a mild method for the cleavage of thioketals into their original ketones or aldehydes has become increasingly important in the organic syntheses

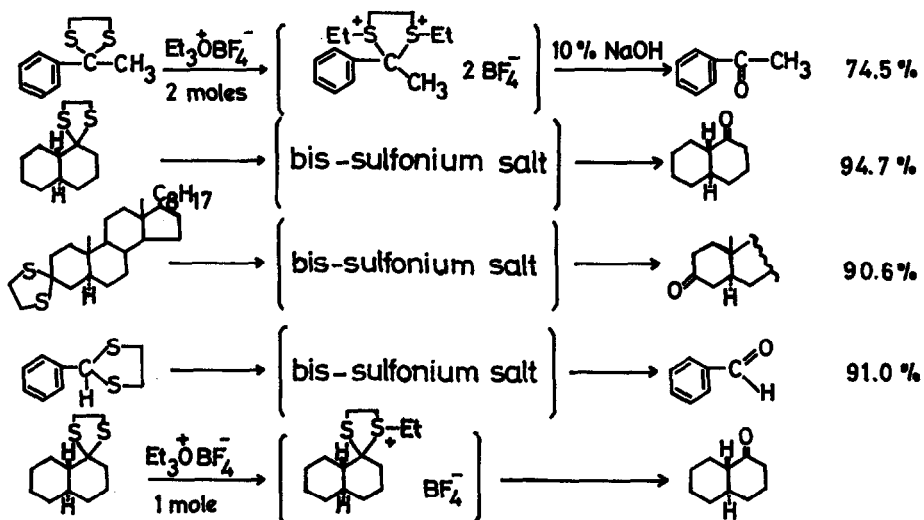
and several oxidative methods⁷⁾ have been reported in addition to the mercuric salts catalyzed cleavage. We intended to facilitate the hydrolysis by converting thioketals into the reactive sulfonium salts by triethyloxonium tetrafluoroborate(2) which is known to combine readily with various sulfides⁸⁾. Reactivity modulation of weak organic bases⁹⁾ through alkylation or acylation has been the subjects of this laboratory and the present study constitutes a typical example along with this line.



The alkylation of cyclohexanone thioketal(1) with a molar equivalent of 2 at room temperature afforded the salt(3) which on alkaline hydrolysis generated only 36% of cyclohexanone, but 32% of 5 along with 6, 7, and 8. The formation of 5 reveals that 7 liberated by the hydrolysis of 3 attacked again the intermediary sulfonium salt(9). These findings show that 7 must be trapped before it combines with 9. When the salt(3) in CH₂Cl₂ was shaken with 3% CuSO₄ solution, cyclohexanone(4) was obtained in the yield of 81% as was expected.

On the other hand, when two molar equivalents of the reagent was used and the resulting salt(10) was treated with 10% NaOH solution, 81% of the ketone(4) was obtained in addition to di-S-ethylethylenethioglycol(8). The formation of 8 shows that the salt(10) must be a bis-sulfonium salt.

Satisfactory results were obtained in the cleavage of thioketals of other ketones or aldehydes applying the present method. It is noteworthy that trans-1-decalone was regenerated almost quantitatively on hydrolysis of the corresponding mono-sulfonium salt even when 5% H₂O₂ solution, a mild oxidizing reagent, was employed as a mercaptan scavenger.



- 1) 10% NaOH ————— 69 %
- 2) 3% CuSO₄ ————— 89 %
- 3) 30% H₂O₂+10% NaOH — 95.7 %
- 4) 5% H₂O₂+10% NaOH — 94.5 %

From these experiments, it was found that when bis-sulfonium salts were once formed by alkylation of thioketals, the original ketones might be recovered in high yield on hydrolysis and even though only the monosulfonium salts were formed by a steric reason or some other factors, the ketones would be generated excellently if the mercaptal(7) was trapped by ambident methods.

Since the reactivity of triethyloxonium tetrafluoroborate(2) as an alkylating reagent is known to be effective but rather selective¹⁰⁾, this method would be applicable to the cleavage of a wide variety of thioketals with other functional groups in the same molecule. Further studies are now being continued to establish the scope and limitations of this new method.

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