Bismuth Trichloride Catalyzed Efficient Reductive Etherification of Carbonyl Compounds with Alcohols: A Novel Method for Preparation of Symmetrical and Unsymmetrical Ethers

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\begin{align*}
R^1COR^2 + \text{Et}_3\text{SiH} & \quad \xrightarrow{\text{cat. BiCl}_3, \text{CH}_2\text{Cl}_2, \text{r.t.}} \quad R^1R^2\text{CHOCH}R^1R^2 \\
R^1COR^2 + R^3\text{OH} + \text{Et}_3\text{SiH} & \quad \xrightarrow{\text{cat. BiCl}_3, \text{CH}_2\text{Cl}_2, \text{r.t.}} \quad R^1R^2\text{CHOR}^3
\end{align*}
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The reductive homocoupling of a carbonyl compound and heterocoupling of a carbonyl compound with a non-protected alcohol were both effected smoothly at room temperature with triethylsilane in the presence of a catalytic amount of bismuth trichloride to afford the corresponding ethers in good yields.