Hydrofluoric Acid

Friedel-Crafts Reactions/ alkylations

Sulfated zirconia (SZ) can catalyze the Friedel-Crafts Fries Rearrangement of benzoate esters instead of HF or other strong Lewis acids.

Clark, J. H.; Dekamin, M. G.; Moghaddam, F. M. Genuinely catalytic Fries rearrangement using sulfated zirconia. *Green Chemistry*. **2002**, *4*(4), 366-368.

Fluorided silica-alumina catalysts in general are more cost efficient and eliminate the need for special handling or special acid scrubbing and disposal of calcium fluoride.

Anastas, P.T.; Warner, J.C. *Green Chemistry, Theory and Practice*. Oxford University Press, 1998.
From Ahluwalia, V. K. and Kidwai, M. *New Trends in Green Chemistry*. Boston, Kluwer Academic Publishers, 2004, p.27.

Fluorided silica-alumina catalysts in the U.O.P.-Petresa process has replaced the use of hydrogen fluoride in the alkylation of benzene.

Horsley, J. A. *Chemtech.* **1997**, *27*(10), 45.
From Matlack, A. S. *Introduction to Green Chemistry*. New York, Marcel Dekker, Inc., 2001, p. 137-138.

Solid acids in place of hydrofluoric acid as a catalyst in alkylation: The addition of carbon dioxide to solid acid catalysts has resulted in steady alkylate production.

Clark, M. and Subramaniam, B. Supercritical 1-butene/isobutane alkylation on solid acid catalysts facilitated by carbon dioxide. *2nd Annual Green Chemistry & Engineering Conference, Global Perspectives: Catalytic Synthesis*, 1998.

Zeolites can be used to replace hydrofluroic acid in the alkylation of isobutane with 2-butene.

Simpson, M. F.; Wei, James; Sundaresan; S. Kinetic Analysis of Isobutane/Butene Alkylation over Ultrastable H-Y Zeolite. *Ind. Eng. Chem. Res.* **1996**, *35*(11), 3861-3873.

Solid acids in a solventless reaction may be used, such as U.O.P.-Petresa catalyst or polymeric perfluorosulfonic acid.

Matlack, A. S. *Introduction to Green Chemistry*. New York, Marcel Dekker, Inc., 2001, p. 137-138.