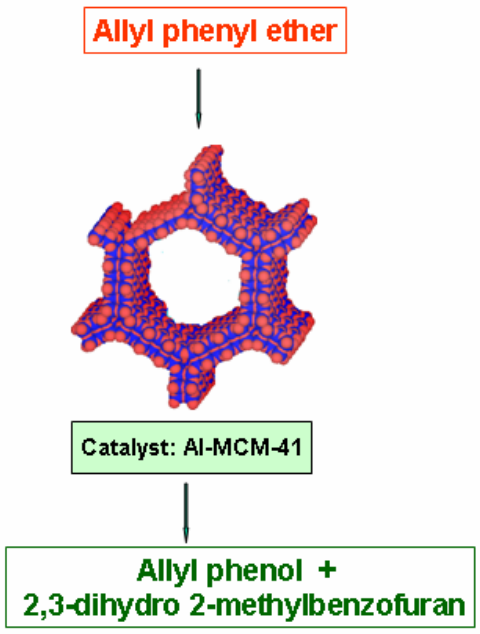
Green catalysis: rearrangement of allyl phenyl ether over Al-MCM-41

Much of the pollution in fine-chemical production arises from the use of mineral acids to catalyze the transformation of organic molecules. Solid acid catalysts like zeolites have now replaced the polluting and corrosive mineral acids in the petroleum and petrochemical industries in most processes requiring acid catalysis. The use of zeolite catalysts in fine-chemical production is rather rare partly due to the large size (greater than 10 Å) of the (reactant and product) molecules often encountered and the small size (less than 8 Å) of the zeolite pores.

Dr. Sivasanker and his team of scientists at National Chemical Laboratory (NCL), Pune, report a green process for the transformation at a low temperature (below 100 ^{0}C) of allyl phenyl ether into the corresponding allyl phenol (Claisen rearrangement) over a mesoporous solid acid catalyst, a reaction that takes place above 200 ^{0}C in the absence of catalyst. Their catalyst can be easily separated from the product mixture after the reaction and reused. Another advantage of this method is the co-production of significant amount of the cyclic compound namely, 2,3-dihydro 2-methyl benzofuran, an important compound in organic synthesis, directly from the allyl phenyl ether through the intermediate allyl phenol. The scientists also report a direct correlation between the acidity of the catalyst and its activity.



The above transformation has also been reported to occur over mineral acids and some large pore zeolites. MCM-41 is a large pore silica with a very large surface area (~1000 m^2/g) and ordered pores in the size range of 20 – 200 Å. It is essentially neutral, but can be transformed into an acidic material by introducing Al-ions in its structure (Al-MCM-41). It is expensive to prepare and its use is not economically attractive in the production of cheap petrochemicals. It is also not very stable thermally to enable its use at high temperatures. Its use, therefore, is justified only in the synthesis of expensive fine-chemicals carried out at low temperatures as reported by NCL scientists.

The NCL team has achieved the ability to transform allyl phenyl ether and its derivatives into ally phenols and benzofuran derivatives at low temperatures over an environmentally safe acidic catalyst whose pores are large enough (~30Å diameter) to transform large molecules. The benefits of this process are better economics due to use of a low temperature, decreased waste and environmental safety.

Mathew, N.T.; Khaire, S.; Mayadevi, S.; Jha, R.; Sivasanker, S. Rearrangement of allyl phenyl ether over Al-MCM-41, Journal of Catalysis, 229(1), 105(2005).

S.G. Wagholikar, S. P. Mirajkar, S. Mayadevi and S. Sivasanker, "Rearrangement of allyl aryl ethers over zeolites", Proc. 14th Intern. Zeol. Conf., (eds. E. van Steen, L. Callanan, M. Claeys and C.T. O'Conner), Cape Town, 25 – 30 April, 2004. p. 2731.

For further information please contact Dr. Sivasanker

To see the list of all R&D features, click here