CHEMICAL & Engineering News

Latest News

March 6, 2006
Volume 84, Number 10
p. 18

Organometallics

Olefin Metathesis

Highly active, water-soluble catalyst promises greener, cheaper processes

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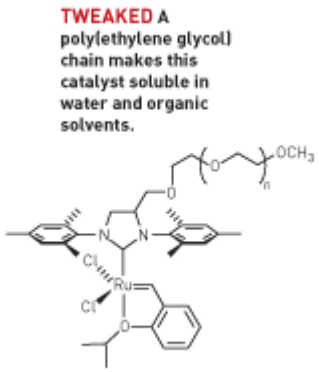

TWEAKED A polyethylene glycol chain makes this catalyst soluble in water and organic solvents.

Olefin metathesis is already regarded as an important way to make carbon-carbon bonds, but the reaction could become even more practical, thanks to a new, highly active, water-soluble catalyst.

The catalyst, developed by California Institute of Technology chemistry Nobel Laureate Robert H. Grubbs and grad student Soon Hyeok Hong, shows "unprecedented activity" in several olefin metathesis reactions in water (*J. Am. Chem. Soc.*, published online Feb. 25, dx.doi.org/10.1021/ja058451c). Because olefin metathesis is widely used in industry, the reagent could make these processes

more environmentally friendly and less expensive.

In olefin metathesis, two carbon-carbon double bonds react to form two new carbon-carbon double bonds, exchanging substituents attached to the carbon atoms in the process. It can lead to substituent swapping, ring closure, diene formation, or polymerization. The reaction relies on a catalyst, and until now, no water-soluble catalyst has been stable enough to efficiently mediate the reaction in aqueous solution.

Grubbs and Hong added a poly(ethylene glycol) or PEG chain to the commercially available Hoveyda-Grubbs second-generation catalyst. This small change leads to a significant alteration in the catalyst's chemistry, rendering it soluble in both water and certain organic solvents. Grubbs thinks the PEG causes the catalyst to form micellelike structures in aqueous solution. These structures, he adds, probably protect the metal center and account for the catalyst's stability.

Ring-closing metathesis reactions carried out in aqueous solution with Grubbs and Hong's catalyst proceed exceptionally well, resulting in good to excellent yields of five- and six-membered rings The catalyst also is highly active in cross-metathesis and in ring-opening metathesis polymerization reactions.

"This is critical and timely progress in catalytic olefin metathesis," comments Boston College chemistry professor Amir H. Hoveyda. It's "an advance that paves the way for this powerful reaction to be applied to many important transformations that must be carried out in water."

Chemical & Engineering News
ISSN 0009-2347