



**GREEN CATALYSTS FOR GREEN CHEMISTRY: NEW CONCEPTS IN OLEFIN  
METATHESIS CATALYSTS SEPARATION AND REUSE**

**L. Gulajski<sup>1</sup>, M. Mauduit<sup>2</sup>, K. Grela<sup>1</sup>**

*1 - Institute of Organic Chemistry, Polish Academy of Sciences, ul. Kasprzaka 44/52, PO Box 58,  
Warsaw, Poland*

*2 - UMR CNRS 6226, Sciences Chimiques de Rennes Ecole Nationale Supérieure Chimie de  
Rennes, 35700 Rennes, France*

*lukasz\_gulajski@o2.pl*

Olefin metathesis has experienced dramatic development as a valuable tool for the formation of C-C double bonds in organic synthesis. This transformation allows chemists to construct sophisticated compounds (e.g. pharmaceuticals, cosmetics, fragrances and fine chemicals).

However, there is one disadvantage related with the use of modern homogeneous metathesis catalysts - it is often not possible to remove heavy metal-containing by-products from the end product. This is a particular problem especially in the pharmaceutical industry, where it is a necessity for compounds to be of high purity and contain no toxic impurities.<sup>[1]</sup> We have reported recently some new concepts for Hoveyda-type ruthenium catalysts separation and reuse.<sup>[2-6]</sup>

Some new results in this direction, including the preparation of tagged catalyst and their application in "classical" organic solvents, in aqueous *solvents* and *neat water* as well as in *ionic liquids* (RTILs) will be presented. In addition, the efficiency of selected commercially available Ru-catalysts (from Materia Inc and Degussa AG) in *aqueous solvents* and *neat water* will be compared.<sup>[7]</sup>

[1] Selected recent reviews stressing this problem: a) Michrowska, A.; Gulajski, Ł.; Grela, K. "«Green» Catalysts for green chemistry: new concepts in olefin metathesis catalysts separation and reuse" *Chem. Today* **2006**, 24(6), 19-22. b) Clavier, H.; Grela, K.; Kirschning, A.; Mauduit, M.; Nolan, S. P. "Clean, Green and Sustainable Chemistry: Applicable Concepts in Olefin Metathesis" *Angew. Chem. Int. Ed.* 2007, 46, 6786-6801 (a review)



- [2] Michrowska, A.; Gułajski, Ł.; Grela, K. "A Simple and Practical Phase-Separation Approach to the Recycling of a Homogeneous Metathesis Catalyst" *Chem. Commun.* **2006**, 841-843 (Hot Article).
- [3] Michrowska, A.; Gułajski, Ł.; Kaczmarska, Z.; Mennecke, K.; Kirschning, A.; Grela, K. "A green catalyst for green chemistry: Synthesis and application of an olefin metathesis catalyst bearing a quaternary ammonium group" *Green Chem.* **2006**, *8*, 685-688.
- [4] Gułajski, Ł.; Michrowska, A.; Narożnik, J.; Kaczmarska, Z.; Rupnicki, L.; Grela, K. "A Highly Active Aqueous Olefin Metathesis Catalyst Bearing Quaternary Ammonium Group" *Chem. Sus. Chem.* **2008**, *1*, 103-109
- [5] Rix, D.; Clavier, H.; Gułajski, Ł.; Grela, K.; Mauduit, M. "Pyridinium-tagged ruthenium complex as efficient catalyst for Ring Closing Metathesis" *J. Organomet. Chem.* **2006**, *691*, 5397-5405.
- [6] Rix, D.; Caijo, F.; Laurent, I.; Gułajski, Ł.; Grela, K.; Mauduit, M. "Highly Recoverable Pyridinium-Tagged Hoveyda-Grubbs Pre-catalyst for Olefin Metathesis. Design of the Boomerang Ligand Toward the Optimal Compromise Between Activity and Reusability" *Chem. Commun.* **2007**, 3771-3773
- [7] Gułajski, Ł.; Śledź, P.; Lupa, A.; Grela, K. "Olefin Metathesis in water using acoustic emulsification" *Green Chemistry* **2008**, *10*, 279-282