

Organic Synthesis Catalyzed by Metal Complexes Immobilized on Structurally-defined Surface †

Kenji Hara ^{1,*}

¹ School of Engineering, Tokyo University of Technology;

* Correspondence: haraknj@stf.teu.ac.jp (K.H.);

† Presented at International e-Conference on Green Chemistry and Engineering towards Sustainable Development – An Industrial Perspective (16-18 June 2021), Surat, Gujarat, India

Received: 5.06.2021; Revised: 10.06.2021; Accepted: 12.06.2021; Published: 15.06.2021

Abstract: Homogeneous catalysis using metal complexes allows us to conduct fine design and tuning of reaction environments. In contrast to such advantages, a fatal disadvantage of metal complex-based catalysis in terms of its practical application is difficulty in the recovery and recycling use of metal species. Immobilization of metal complexes on insoluble support materials is typical to overcome such disadvantages of homogeneous catalysis while keeping its advantages. In addition to such practical outcomes of immobilization, our research group has focused on finding unique catalytic functions by utilizing structurally defined surfaces as support materials. Rh complexes were immobilized on the gold surface via a high-density monolayer of thiol and diisocyanate molecules and applied in catalytic dehydrogenative silylation of alcohols and the hydrosilylation of enones, respectively. Periodic mesoporous silica (PMO) is another support material for immobilization to be presented. Ru complexes were immobilized on PMO and applied in a C-H bond oxidation reaction. Striking features observed in these studies include observation of extremely high chemo or product selectivity and high catalyst turnover number. It is expected that the unique catalytic functions realized by the present methods will be utilized in the synthesis of pharmaceuticals and functional chemicals in the industry.

Keywords: gold surface; periodic mesoporous organosilica; dehydrogenative silylation; hydrosilylation; C-H bond oxidation.

© 2021 by the authors. This article is an open-access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Funding

This presentation is based on the results obtained from projects supported by ACT-C, JST, and JSPS KAKENHI Grant Numbers JP19H02715, Grant-in-Aid for Scientific Research (B), JP18H04273 and JP16H01041 in Precisely Designed Catalysts with Customized Scaffolding, JP25106010 in Grant-in-Aid for Scientific Research on Innovative Areas “Nano Informatics” and JP15K05492, Grant-in-Aid for Scientific Research (C).

Acknowledgments

The authors acknowledge Dr. Shinji Inagaki, Toyota CRDL and Prof. Masaya Sawamura, Prof. Atsushi Fukuoka, Hokkaido University, for the collaboration of the studies. XAFS structural characterization was conducted at the BL14B2 of Spring-8 with the approval of the Japan Synchrotron Radiation Research Institute (JASRI) (Proposal No. 2014B1661, 2015A1728, 2016A1552, 2016A1774, 2016B1582, 2017B1635, 2017B1916, and 2018A1791).

Conflicts of Interest

The author declares no conflict of interest. The funders had no role in the design of the study, in the collection, analyses, or interpretation of data, in the writing of the manuscript, or in the decision to publish the results.