

## Supercritical Route for Green Materials

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Green materials processing is a philosophy of chemical research and engineering to encourage the design of products and processes that minimize the use and generation of hazardous substances, which involves 1) contribution of products to minimize environmental problems (CO<sub>2</sub> emission, environmental cleaning catalyst etc.), 2) recycle of materials to resources, 3) holistic life cycle assessment of the materials, and 4) combined multiple technological and operational systems for reduction of energy and resources. Supercritical fluids technology is expected to contribute for new materials synthesis with the green sustainable chemistry route, especially for nanomaterials.

So far, variety of materials have been developed, including ceramics, metals and polymers, but recent needs in the industries are of multi-functions of ceramics/metals and polymers. For fabricating multi-functional materials, we proposed a new method to synthesize organic modified nanoparticles (NPs) in supercritical water. Since the organic molecules and metal salt aqueous solutions are miscible under the supercritical state, and water molecule works as an acid/base catalyst for the reactions, organic-inorganic conjugate nanoparticles can be synthesized under the condition. This synthesis method can control the exposed surface of NPs, which shows high catalytic activity of nano-catalysis; This promotes the bitumen or biomass waste decomposition (endothermic reaction) at lower temperature without coke formation. This gives rise to recover the waste heat and the waste treatment problems at the same time, namely solve the energy (CO<sub>2</sub>) problems.

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### Education

1981 Chemical Engineering, The University of Tokyo

1983 Chemical Energy Engineering, The University of Tokyo

1986 Chemical Engineering, The University of Tokyo (Doctor of Engineering)

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### Professional Experience

JSPS Fellow, Department of Chemical Engineering, The University of Tokyo 1985-1987

Assistant professor Department of Chemical Engineering The University of Tokyo 1987-1989

Assistant professor Department of Bio and Chemical Engineering, Tohoku University 1989-1991

Associate Professor Department of Bio and Chemical Engineering, Tohoku University 1991-2001

Professor Institute of Multidisciplinary Research for Advanced Materials Tohoku University 2001-present

Professor WPI-Advanced Institute for Materials Research, Tohoku University 2007-present

### Fields of Research

Supercritical Fluids, Nanoparticles

### Publications

1. M. Taguchi, S.Takami, T. Adschiri, T. Nakane, K. Sato, T. Naka, *Cryst. Eng.Comm.* **13** 2841(2011)
2. S.Asahina, S.Takami, T. Otsuka, T.Adschiri, O.Terasaki, *ChemCatChem* **3** 1038(2011)
3. J.Zhang, H.Kumagai, K.Yamamura, S.Ohara, S.Takami, A.Morikawa, H.Shinjoh, K.Kaneko, T.Adschiri, A.Suda, *Nano Letters***11**(2) 361(2011)
4. Byrappa K, T. Adschiri, *Progress in Crystal Growth and Characterization of Materials* 53 117(2007)
5. J.Zhang, S.Ohara, M. Umetsu, T. Naka, Y. Hatakeyama, T. Adschiri, *Advanced Materials* 19) 203(2007)