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Research field: Catalyst, Solar-energy conversion

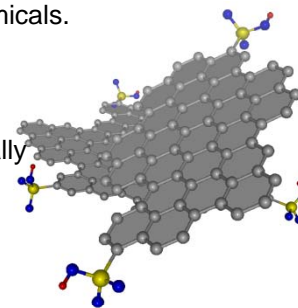
## Research topics conducted within the G-COE project

### 1. Protonic solid

We have been consuming huge energy for the production of essential chemicals. Minimizing energy consumption for the chemical production, eco-friendly production of chemicals, would essentially decrease environmental load such as greenhouse gas. Amorphous carbon with a high density of sulfonic acid groups, a protonic solid developed by our group, functions as an insoluble and stable solid sulfuric acid catalyst, minimizing energy consumption for the production of industrially important chemicals.

### 2. Biofuel

Biofuels such as bioethanol and biodiesel is currently in fashion as carbon neutral liquid fuels. The production of these fuels, however, is not environmentally benign, resulting in huge energy consumption. We are trying to develop innovative catalyst minimizing environmental load for the production of biofuels.



### 3. Solar-cell

Semiconductors synthesized from abundant natural resources with low energy consumption would innovate solar-energy conversion by solar-cell. We have just succeeded in the development of carbon solar-cell readily produced by abundant resources.

A protonic solid "sugar catalyst": amorphous carbon with a high density of sulfonic acid groups  
Sugar catalyst function as a innovative solid catalyst for the production of industrially important chemicals and biofuels.

## Representative publications

- J. Am Chem. Soc., 127, 8286, 2005 "GaN:ZnO as a Photocatalyst for Visible-Light-Driven Overall Water Splitting"  
J. Am Chem. Soc., 127, 4150, 2005 "RuO<sub>2</sub>-Loaded B-Ge<sub>3</sub>N<sub>4</sub> as a Non-Oxide Photocatalyst for Overall Water Splitting"  
Nature, 438, 178, 2005 "Biodiesel made with sugar catalyst"  
Advanced Materials, 17, 1839, 2005, "A Stable and Highly Active Hybrid Mesoporous Solid Acid Catalyst"  
Angew. Chem. Int. Ed. 43, 2955, 2004, "A Carbon Material as A Strong Protonic Acid"  
Angew. Chem. Int. Ed. 42, 2382, 2003, "Crystallization of an ordered mesoporous Nb-Ta oxide"  
J. Am Chem. Soc., 125, 5479, 2003, "Exfoliated Nanosheets as a New Strong Solid Acid Catalyst"  
J. Am Chem. Soc., 124, 13547, 2002, "Oxysulfide Sm<sub>2</sub>Ti<sub>2</sub>S<sub>2</sub>O<sub>5</sub> as a photocatalyst under visible light irradiation "