

# FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

**Project Title:** Development of new catalysts and new materials: Catalytic reaction utilizing carbon monoxide and carbon dioxide

**Name:** Kyoko NOZAKI

**Institution:** The University of Tokyo

## 1. Background of research

Modern chemical industry relies its starting materials on fossil resources. In order to realize the sustainable society, it is essential to find carbon resources independent from petroleum. Chemical industry utilizes catalysts to accelerate the reactions and/or to elevate the selectivities of the desired products. The catalysts often consist of rare metals and their supply is also unstable.

## 2. Research objectives

The purpose of this research is to develop new catalytic reactions utilizing carbon monoxide and carbon dioxide as starting materials. The purpose should be accomplished by using universal and less toxic metals. Development of new materials will be also examined based on the discovery of new catalytic reactions.

## 3. Research characteristics (incl. originality and creativity)

In order to find new catalysts, here we propose a concept "net-charge strategy". This methodology is proposed to examine the metals only based on the net charge of the metal centers regardless to where the metal is located in the periodic table. The view point clearly differs from the conventional ones which have base on the utilization of the same or neighboring metals to use.

## 4. Anticipated effects and future applications of research

Chemical products such as plastics or fibers will be able to be prepared from CO and/or CO<sub>2</sub> and chemical industry will be free from using fossil resources. The chemical industry will also rely less on rare metals. Thus, the success of the project will strongly impact the future development of sustainable industry in Japan.

## Development of new catalysts and new materials

CO

More efficient usage

CO<sub>2</sub>

Conversion to useful materials

# Net-charge strategy: Method to find new catalysts

CO

Innovation in oxo-process

1. Can Ru be a substitute for Rh?  
less expensive and readily available  
(five times in Clark number)
2. Activities unique for Ru
  - Hydrogenation of aldehyde
  - Use of CO<sub>2</sub> but not CO.
3. Possible to use other metals,  
e.g. Fe?

CO<sub>2</sub>

Synthesis of CO<sub>2</sub> polymers

1. Any substitutes for Co and Cr?
  - with less toxic metals
2. Activities unique for Ti
  - Higher activities
  - Catalyst separation and recovery

Synthesis of new materials from CO

New ligands for Pd(II) that enable to produce new materials