【Grant-in-Aid for Scientific Research (S)】

Integrated Disciplines (Environmental Science)

Title of Project : Physical Photochemical Functionalization of Oxide Nanotubes through Hierarchical Structure Tuning

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Research Project Number : 15H05715 Researcher Number : 20226658
Research Area : Environmental Science
Keyword : Sound material recycle system

【Purpose and Background of the Research】

The present researcher repoted that titania nanotube (TiO_2 nanotube, TNT) with open-end nano-tubular structure, typically 8-10 nm in outer-diameters, could be successfully synthesized by simple and low temperature solution chemical route without using any template. Because of synergy combination of low-dimensional nanostructure and physicochemical aspect of TiO_2, the TNTs exhibited various excellent physical and photochemical functions such as coexistence of photocatalytic properties and high molecular adsorption function, showing the TNT is a real multifunctional nanomaterial. High potential not only environmental functions but also energy havesting functions such as solar cell electrode has confirmed, implying it opens a new window to oxide semicondoctors as advanced environmental, energy creation and biocompatible materials and systems.
In this project, novel nanostructural tuning will be attempted to the oxide nanotubes to enhanse their phsycal photochemical multifunction further through processing development and optimization. Final goal is thus to develop hyper-multifunctional low-dimensional oxide nanotubes for advanced next generation environemtal cleaning materials, energy havesting/materials conversion catalysts, and biocompatible functional nanomaterials.

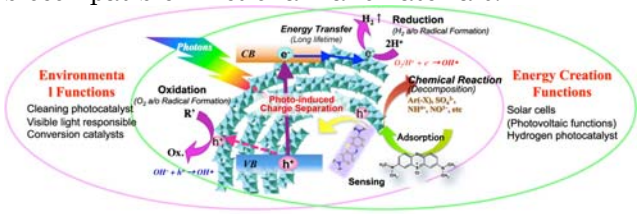

Fig.1 Materials characteristics of oxide nanotubes and development concdept of the project.

【Research Methods】

To achieve research goals, this project will focus on hierarchical materials tuning and synthesis, structure and function analysis, and clarifying the roles of low-dimensional nanostructures on various physical photochemical functions. In detail, lattice-level modification of nanotubes by ion doping and immobilization of metals, compounds and organic molecules and polymers will be carried out. As the example, titania nanotubes (TNTs) will be modified by ion doping based on the band engineering to tune their semiconductive properties. One of the goals of this tuning lies in the development visible-light responsible photocatalyst. On the other hand, immobilizing various materials will be carried out to realize 0-dimensional and 1-dimentional heterogeneous low-dimensional nanocomposites, which would exhibit better photochemical performance.

【Expected Research Achievements and Scientific Significance】

Through the project, we will develop novel low-dimensional oxides with excellent physical photochemical functions, which might become next generation high-performance environmental and energy materials. In addition, systemization of science and engineering of oxide nanotube materials would be achieved through the detailed investigation on the synthesis, nanostructure and functions. Through the study, we will demonstrate materials tuning methodology that contributes realization of advanced friendly nanomaterials.

【Publications Relevant to the Project】

・ D. J. Park, T. Sekino, S. Tsukuda, S.-I. Tanaka, *Res. Chem. Intermed.,* **39**, 1581-1591 (2013).
・ T. Sekino, *Ceram. Jpn.*, **41**[4], 267-271(2006).
・ T. Kasuga, M. Hiramatsu, A. Hoson, T. Sekino, K. Niihara, *Langmuir*, **14**, 3160-63(1998).

【Term of Project】 FY2015-2019

【Budget Allocation】 153,700 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.sanken.osaka-u.ac.jp/labs/mmp/