FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Anisotropic Shape Control of Semiconductor Nanoparticles Using Photochemical Techniques and Their Application to Solar Light Energy Conversion Systems	
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1. Background of research

One of the promising strategies to solve the problem of global warming and fossil fuel depletion is to efficiently utilize the solar energy. Though Si solar cells have been used most commonly for the conversion from solar light to electricity, their efficiency is about 30% of solar energy at best. Recently many researchers have been eagerly trying to develop novel solar cells with much higher conversion efficiency.

2. Research objectives

In this study, we will fabricate novel solar cells with use of semiconductor nanoparticles (quantum dot) having absorption in the visible and infrared wavelength region, and then try to increase the solar light-electricity conversion efficiency.

3. Research characteristics (incl. originality and creativity)

Semiconductor nanoparticles exhibit the size- and shape-dependent physicochemical properties due to the quantum size effect. We will precisely control the dimension of semiconductor nanoparticles using the size-selective photoetching technique that has been originally developed by us. Photoelectrochemical properties of thus-obtained nanoparticles are investigated to evaluate the influence of the size and shape of semiconductor nanoparticles on the light energy conversion efficiency.

4. Anticipated effects and future applications of research

Conventional solar cells, such as Si cells, cannot effectively utilize solar light with wavelength in ultraviolet and infrared regions. On the other hand, since semiconductor nanoparticles (quantum dots) have tunable absorption properties, quantum dot solar cells are expected to effectively convert solar light in the whole wavelength region, by controlling the size and shape of semiconductor nanoparticles. Their theoretical solar light conversion efficiency has been reported to reach about 60%. If these solar cells are in the practical use in future, the amount of electricity produced by solar light per unit area will increase several times, resulting in the remarkable reduction in the use of fossil fuels.