Investigation of the role of metal nanoparticles for active utilization of photon energy based on charge separation at the nanointerface

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The development of technologies for effective utilization of solar energy is desired, and metal nanoparticles that exhibit localized surface plasmon resonance (LSPR) have attracted widespread attention as a material that can make this possible. This is because the LSPR of metal nanoparticles produced by irradiating light at resonant wavelengths can theoretically increase the photoenergy of incident light on the particle surface by tens to millions of times. Furthermore, in systems combined with semiconductors, plasmon-induced charge separation (PICS) proceeds at the interface between the metal nanoparticles and the semiconductors, and photoenergy can be converted to electrochemical energy [1]. On the other hand, the introduction of metal nanoparticles may have the opposite effect, depending on the design, because quenching of excited states also occurs on the surface of the metal nanoparticles [2,3]. Therefore, it is important to clarify these effects, but the details of how each of the above effects affects the conversion efficiency are still unknown.

The aim of this study was to clarify the effect of gold nanoparticles exhibiting LSPR on photocatalytic properties when supported on a photocatalyst. As a result, we succeeded in obtaining knowledge for establishing an efficient production method for hydrogen, which is expected to be a next-generation fuel [4]. The findings are expected to be useful for the design of highly efficient photoenergy conversion devices.

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