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Significant enhancement of Photoluminescence intensity of Si quantum dot by Medusa-type Ag nanostructure

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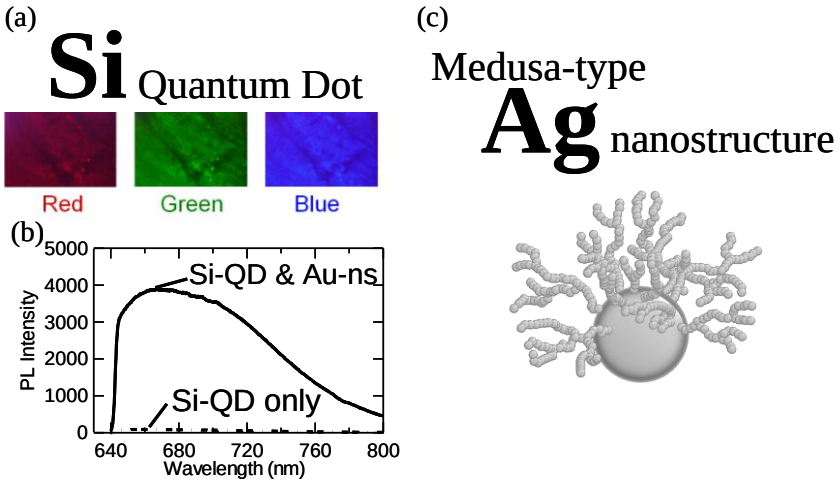
We have performed the pulsed laser ablation of solid materials in a supercritical fluid to generate silicon (Si) and metal (Au, Ag, etc.) nanoparticles [1-4]. In the previous studies, we succeeded in generating RGB-light-emitting Si quantum dots (Fig. a) [2] and Au nanostructure [3], having a great enhancement factor of surface-enhanced Raman scattering (SERS). Here we show the photoluminescence (PL) enhancement of Si quantum dot (Si-QD) by Au nanostructure. [5]

We conducted the PL spectral measurements of Si-QD upon the excitation of the Ag nanostructure. As a result, we found the PL intensity enhancement of Si-QD due to the localized surface plasmon resonance of Ag nanostructure (Fig. b). In particular, the significant enhancement was obtained when the Medusa-type Ag nanostructure (Fig. c) was used; i.e. Enhancement Factor is ranging from 10^3 to 10^5. This means that the localized surface plasmon of Ag nanostructure enhances the PL intensity of Si-QD from 10^3 to 10^5 times.



(a) Photoluminescence images measured with a fluorescence microscope at the excitation wavelength of 375 nm. (b) Photoluminescence spectra at the excitation wavelength of 633 nm. Solid and dashed lines are photoluminescence spectra of Si-QD with and without Medusa-type Ag nanostructure, respectively. (c) Morphology of Ag nanostructure. We call its structure a Medusa-type Ag nanostructure.

References

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