Facile and inexpensive biocatalytic method for resizing of semiconductor cadmium sulfide nanoparticles

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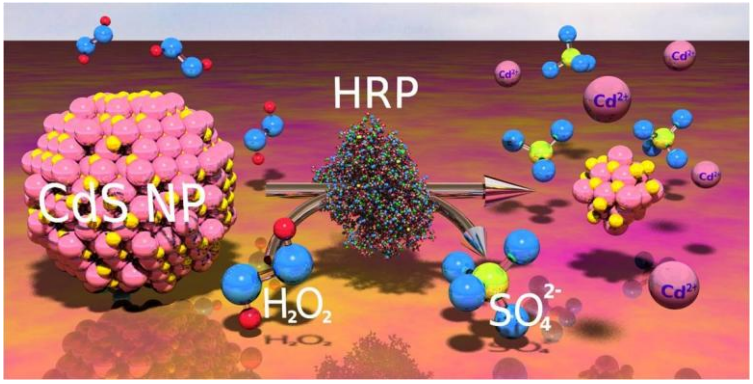
Chemical and physical properties of semiconductor nanoparticles (NPs) or quantum dots (QDs) are defined by three dimensional structure of NPs, therefore very slight changes in shape and size lead to drastic variation in absorption and emission spectra.[1] Further post-processing for resizing and tailoring of already prepared semiconductor NPs is often necessary. Etching technology is considered to be a particularly important process to resize semiconductor NPs and to tune their luminescence properties.
We report for the first time that semiconductor CdS NPs treated with HRP in the present of different concentrations of H_2O_2 gradually decreased in size (Scheme 1).[2] It was proved by the blue-shift of emission peak, decrease in the intensity of the in fluorescence and by transmission electron microscopy images.
This phenomenon was also applied for the first time to monitor photoluminescence during etching of CdS NPs in real time. For this experiment CdS NPs where immobilized on the surface of microbeads and after adding all components fluorescence was measured. In order to take images of CdS NPs during etching wide field fluorescence microscopy was used.
The present approach discovered by us could find a broad range of applications in analytical chemistry and open up a new path for enzymatic modification and modulation of bioelectronic devices based on semiconductor NPs.

References

[1] Parak, W. J.; Manna, L.; Simmel, F. C.; Gerion, D.; Alivisatos, P. In Nanoparticles; Wiley-VCH Verlag GmbH & Co. KGaA, (2005) 4-49
[2] R. Grinyte, L. Saa, G. Garai-Ibabe, V. Pavlov. Chem. Commun., Chem. Commun., 2015, 51, 17152-17155

Figures



Scheme 1. Enzymatic etching of CdS NPs.