

**Formation of TiO₂-based Heteronanojunctions Using the Photodeposition
Technique for the Applications to Solar Energy**

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Today's my lecture focuses on the heteronanojunctions (HNJs) between narrow gap semiconductors and wide gap semiconductor (TiO₂), while we have mainly studied the photocatalysis of noble metal nanoparticle-loaded TiO₂ under UV light irradiation for the last decade (*Chem. Soc. Rev.* **2009**, 38, 1849). We have recently found that metal sulfide quantum dots (QDs) can be directly coupled with TiO₂ by taking advantage of its photocatalysis. After a brief discussion on the reaction mechanism, three important features of the photodeposition (PD) technique are highlighted from a viewpoint of solar energy conversion: (i) efficient visible light –induced interfacial electron transfer is guaranteed, (ii) the band energies of metal sulfides are tunable only by irradiation time, and (iii) high coverage of the TiO₂ surface with metal sulfide QDs can be achieved. Then, I describe the applications to the HNJ-based nanodevices including solar cells, photoelectrochemical cells for hydrogen acquisition, and artificial photosynthesis. The excellent performances of the devices using the HNJ as a key component prepared by the PD technique are discussed in connection with the features of the PD technique.