Separation of photogenerated charges in TiO_2 and $BaTiO_3$ nanoparticles

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Photocatalytic hydrogen production continues to be an attractive approach for the generation of a carbon-free energy source. However, the efficiency of the solar energy conversion process is mainly limited by the recombination of photogenerated electron-hole pairs in the photocatalytic material along with the back-reaction of the intermediate species.[1] It was shown that the use of a ferroelectric metal oxides in combination with photocatalytic materials components enhance the charge carrier lifetimes and promotes spatially selective photochemical reactions at the surface of the ferroelectric material.[2]

Here, we aim at an evaluation of charge separation properties of $BaTiO_3$ nanoparticles where ferroelectric polarization effects may enhance charge separation and, hence, diminish the recombination of photogenerated charges. For this reason, we compared vapor phase grown TiO_2 nanoparticles with $BaTiO_3$ nanoparticles from Flame Spray Pyrolysis with regard to light induced charge separation as investigated with Electron Paramagnetic Resonance (EPR) spectroscopy.[3] In a complementary synthesis approach we produced nanocomposites of titanium dioxide (TiO_2) nanoparticles that are coated with barium, barium oxide or a barium titanate phase. In addition to the structural analysis via X-ray diffraction (XRD), we analysed structure and composition of particles and particle interfaces between the different materials components with transmission electron microscopy (EDX/ TEM).

[1] Li Li et al, Nanoscal. 2014, 6, 24

[2] Nina V. Burbure et al, Chem. Mater. 2010, 22, 5823

[3] Berger T. and Diwald O., Chapter 8, RSC Energy and Environment Series. Photocatalysis: Fundamentals and Perspectives. 2016, 14, 185