

INVITED ORAL PRESENTATION

The influence of molten salts on SrTiO₃ photocatalyst surfaces: surface restructuring and ion exchange

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SrTiO₃ photocatalysts for water splitting can have quantum efficiencies exceeding of 90 % at 350 nm. While a key step in the synthesis of such a catalyst is treating it in molten SrCl₂, it remains unclear exactly how the molten salt changes the SrTiO₃ and how these changes are related to the improved reactivity. We have investigated the influence of molten SrCl₂ on the surface structure, composition, electric potential, and photochemical properties of SrTiO₃ single crystals. The salt increases the difference in the electric potentials of the (100) and (110) surfaces, which promotes the separation of photogenerated electrons in holes. We have also found that SrTiO₃ can be synthesized from other perovskite structured oxides by ion exchange in the molten salt. For example, when BaTiO₃ is heated in an excess of molten SrCl₂, it converts to SrTiO₃. The SrTiO₃ synthesized by ion exchange produces hydrogen from pH 7 water at a rate more than twice that of conventional SrTiO₃ treated identically. The catalyst resulting from ion-exchange differs from conventional SrTiO₃ by having ≈ 2 % residual Ba, inhomogeneous Cl-doping at a concentration less than 1 %, Kirkendall voids in the centers of particles that result from the unequal rates of Sr and Ba diffusion, and nanoscale regions near the surface that have lattice spacings consistent with the Sr-excess phase Sr₂TiO₄. The increased photochemical efficiency of this non-equilibrium structure is most likely related to the Sr-excess, which is known to compensate donor defects that can act as charge traps and recombination centers.