Mixed ionic and electronic conducting (MIEC) perovskite oxides are important for several energy applications. Among those, (Fe-doped) strontium titanate (Fe:STO) is one of the best investigated materials. The band gap of STO of ~3.2 eV at room temperature enables several effects upon UV irradiation, revealing a much more complicated interplay of charge carriers than for purely electronic photoactive materials.

STO and Fe:STO single crystals were investigated to study photochromism, photoconductivity, changes in oxygen surface kinetics, and photo-related oxidation or reduction reactions. A bulk-related color-change of Fe:STO single crystals at elevated temperatures from pristine yellowish/transparent to black upon illumination was investigated. Due to enhanced oxygen incorporation upon illumination, the bulk stoichiometry of the whole single crystal is changed, which results in the color change. The investigated electrochemical properties showed a defect chemical state equivalent to an internal p(O2) >10^9 Pa. Additionally the influence of different electrodes in photoelectrochemical devices based on STO are investigated. These defect chemical changes can also be exploited in high temperature photovoltaics, in solid photoelectrochemical cells (SOPEC) or in a “light charged” battery. Here, STO was used together with thin films of yttria stabilized zirconia and different top- and bottom-electrodes to generate photocurrents and photovoltages of up to 850 mV at 360-400°C.