Highlights

Activity A - Novel superconducting and functional materials for energy and environment - 2021

Defect engineering for tuning the photoresponse of ceria-based solid oxide photoelectrochemical cells

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Solid oxide photoelectrochemical cells (SOPECs) with inorganic ion-conducting electrolytes provide an alternative solution for light harvesting and conversion. Ceria-based thin films were newly explored as photoelectrodes for SOPEC applications. It was found that the photoresponse of ceria-based thin films can be tuned both by Sm doping-induced defects and by the heating temperature of SOPECs (Fig.1). The whole process was found to depend on the surface electrochemical redox reactions synergistically with the bulk photoelectric effect. Samarium doping level can selectively switch the open-circuit voltage polarity of SOPECs under illumination, thus shifting the potential of photoelectrodes and changing their photoresponse. In this work the role of defect chemical engineering in determining such a photoelectrochemical process was highlighted and explained.
Transient absorption and X-ray photoemission spectroscopies, together with the state-of-the-art in operando X-ray absorption spectroscopy, allowed us to provide a compelling explanation of the experimentally observed switching behavior on the basis of the surface reactions and successive charge balance in the bulk.

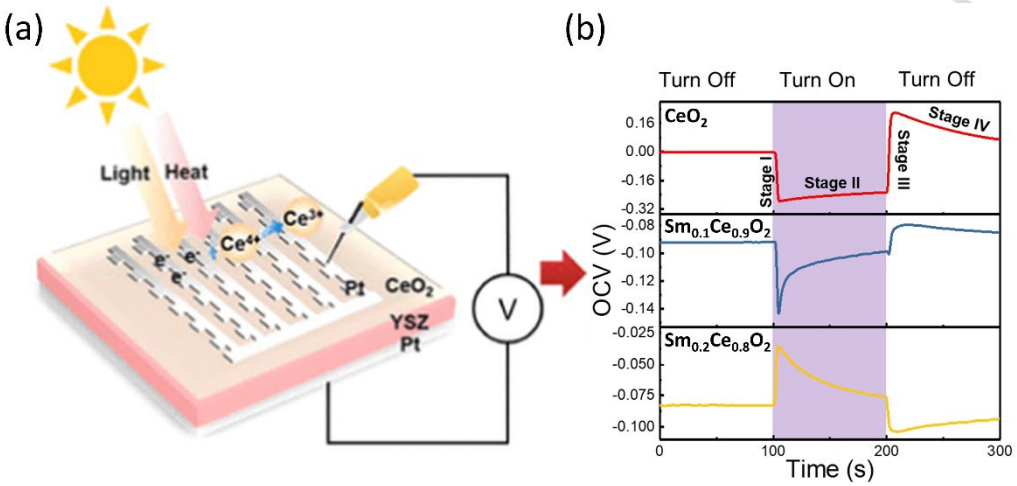

Fig. 1: (a) Sketch of working and measurement setup. (b) Open circuit voltage (OCV) dependence with time of the undoped ceria, 10% Sm and 20% Sm doped ceria based structures at 300°C in air. The whole OCV behavior is completely reversed for highest Sm doping content compared to the undoped one.