Photovoltages in perovskite-type oxide thin film cells

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High temperature solid oxide photovoltaic (PV) cells are promising due to their possible combination with solid oxide electrolyzer cells (SOEC). By using a common electrode of a PV cell and an underlying SOEC it is possible to directly transfer light to chemical energy. However, optimization of voltage and power of such high temperature PV cells is still required [1]. In this study, different material combinations were tested for their applicability in oxide based perovskite solar cells.

The junction between different substrates and thin films was studied under UV light irradiation and the resulting photovoltages and power outputs were measured. A first group of cells is based on p-n junctions. Nb:$SrTiO_3$ substrates were combined with Fe:$SrTiO_3$ thin films of different Fe content (2 at% - 10 at% Fe at the B site) and different cation nonstoichiometry. Also the inverse case (Nb:$SrTiO_3$ thin films) was analyzed. A second group of cells uses heterostructures, e.g. undoped $SrTiO_3$ substrates with (La,Sr)CrO_3 (LSCr) thin films on top. This leads to photovoltages as high as 0.95 V at 350 °C. In addition, other perovskite type oxides were also tested, such as (La,Sr)CoO_3 (LSC), (La,Sr)FeO_3 (LSF) and (La,Sr)(Cr,Mn)O_3 (LSCrM). Optimization regarding film thickness and film preparation procedure was carried out to reach maximum performance and stability.

References

[1] G.C. Brunauer, B. Rotter, G. Walch, E. Esmaeili, A.K. Opitz, K. Ponweiser, J. Summhammer, J. Fleig; Adv. Funct. Mater., 26 (2016) 120-128