**Link:** [https://solar-power-tech.com/e-posters/sfs\_eposter\_08/](https://solar-power-tech.com/e-posters/sfs_eposter_07/)

**Abstract**

Barium stannate (BaSnO3) crystallizes as the cubic perovskite-type structure (Pm3m) and typically exhibits a wide bandgap of >3.0 eV, thus rarely considered as a viable photo-absorber material for efficient solar energy conversion.1 In this study we optimized a spray pyrolysis method to fabricate phase pure BaSnO3 photoanodes. By annealing these BaSnO3 photoanodes in 10% H2 / 90% N2 gas at 350 oC, we observe a decrease in the effective band gap to ~1.5 eV, and an enhanced photoelectrochemical performance; with a ~5-fold improvement in the photocurrent density reaching ~0.5 mAcm-2 at 1.23 VRHE and an improved onset potential of ~0 VRHE. We have used a set of complimentary spectroscopy techniques, including IPCE measurements, PL analysis, wavelength-dependent TR-SPV, TRMC and time resolved terahertz spectroscopy (TRTS), to determine the charge carrier properties and energetic positions of specific intra-band gap states within different BaSnO3 thin films. By combining these results with X-ray photoelectron spectroscopy (XPS) we were able to identify that mild H2 annealing of BaSnO3 generates set of mid-gap defect states associated with oxygen vacancies (), and Sn2+ centres ().2 Increasing the population of these mid-gap states, shifts the optical onset of photocurrent collection and mobile charge carrier generation to photon energies as low as ~1.5 eV. The picosecond charge carrier mobility measured from TRTS shows that the peak mobility of the BaSnO3 film increases from 0.84 to ~1.65 cm2V-1s-1 (at h*ν* = 3.0 eV) after H2 treatment, which is particularly high in comparison to other metal oxides (such as BiVO4 and SnWO4) measured with the same techniques.3,4 Furthermore, the extended carrier life-times obtained from the transient signals, which span from the pico- to the micro-second time domains, provides evidence of a transport mechanism where carriers are able to tunnel through delocalized defect states. Unlike, conventional metal oxides, such as TiO2, which are structurally less tolerant to such high concentrations of defects, we show here that BaSnO3 manifests properties that enables the modification of the optical absorption and electronic structure without compromising the charge transport properties. This insight offers an exciting opportunity to dope and engineer perovskite structured metal oxides as prospective photocatalysts and absorber materials.

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