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The impact of synthesis techniques on the properties of hybrid perovskite materials for photovoltaic application

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Abstract

Hybrid perovskites are organometal halide materials that are attractive to the researchers owing to impressive physical properties like absorption coefficients. Controlled formation of perovskite crystal during the preparation process is key to achieving better morphological features, thereby influencing the material's properties. In this paper, we examined the impact of two synthesis techniques as well as new material composition on the properties of the perovskite materials. These perovskite materials were produced by one- and two-step solution processes and the kinetics of the composition of perovskite were characterized by the following techniques: UV-vis spectroscopy, X-ray diffraction (XRD) and Thermo gravimetric analysis. The electrochemical properties were examined by cyclic voltammetry using the two-electrode system. All samples exhibited an absorption onset around 850 nm which corresponded well with the energy gap (~1.55 eV). The two-step process resulted in smooth XRD patterns, hence exhibiting improved crystallinity owing to sharper peaks than those from one-step process. The sample crystallite sizes ranged of 44–81 nm. We conclude that two synthesis techniques together with new materials composition showed better thermal stability compared with previous reports. Cyclic voltammetry indicated that the perovskite electrodes exhibited stable electrochemical performance and easy charge transfer during the reaction. Our results suggest better electrochemical properties with possible capacitance which is beneficial for energy storage devices.