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ENHANCED PERFORMANCE OF MAGNETRON SPUTTERED LEAD FREE PEROVSKITES THIN FILMS BY THERMAL TREATMENT

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Abstract

Perovskites are ones of the most promising materials for the realization of the new generation of solar cells. Mixed organic-inorganic perovskites were the first ones proposed but they presented low stability on Ambiental condition. By substituting the organic cations with Pb^{2+} the stability of the materials increases but the presence of lead, toxic both for environment and humans, is not practicable. Here we present an innovative way for the deposition of the lead free totally inorganic Cs3Bi2I9 perovskite from vapor phase. By taking use of a magnetron sputtering system equipped with a radiofrequency working mode power supply and a single target containing the correct ratio of both CsI and BiI3 salts, it was possible to deposit a perovskitic film on silicon and soda lime glass. The target composition was optimized to obtain a stoichiometric deposition and the best compromise was founded with a mix enriched with 20% w/w of CsI. Secondly, the effect of post deposition thermal treatments (150 °C and 300 °C) and of the deposition on a preheat substrate (150 °C) were evaluated by SEM, XRD and XPS techniques. The thermal treatment at 150 °C improved the uniformity of the perovskite film without degrading it, the one at 300 °C damaged the perovskite deposited. By deposition the perovskite on a preheated substrate at 150 °C the obtained film showed a higher crystallinity, and no degradation phenomena was observed. An additional thermal treatment at 150 °C on the film deposed on the preheated substrate was evaluated and it showed that the crystallinity remains high, like the one of the not treated film, but the morphology was more uniform, and no degradation phenomena was observed.

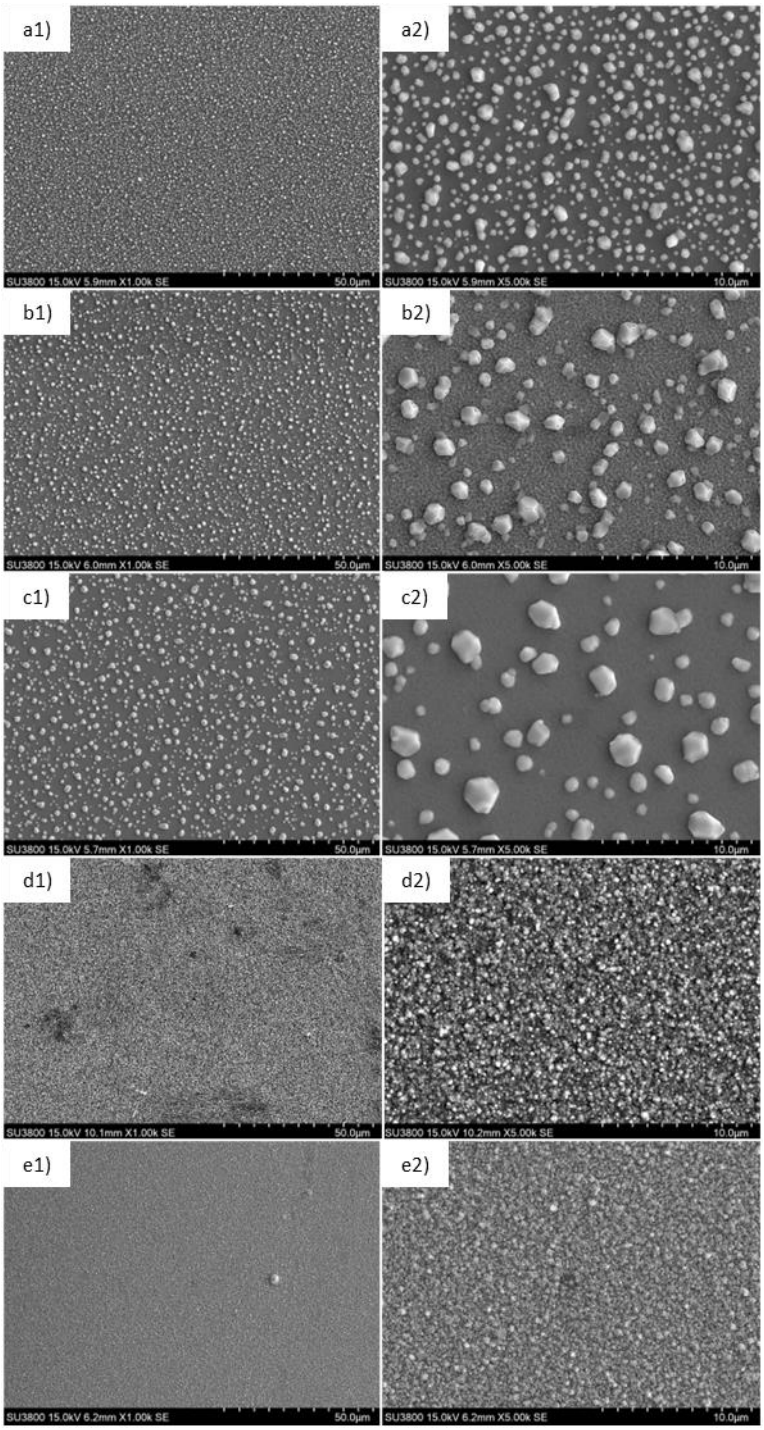

Figure 1. SEM images of a) pristine perovskite film, b) perovskite film annealed at 150 °C, c) perovskite film annealed at 300 °C, d) perovskite film deposed on preheated substrate at 150 °C and e) perovskite film deposed on preheated substrate at 150 °C and annealed at 150 °C.