

MORPHOLOGY AND PIEZORESISTIVITY OF LEAD-FREE (TMSO)₃Sn_{3x}Bi_{2(1-x)}I₉ HALIDE PEROVSKITE THIN FILMS INFLUENCED BY BISMUTH

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The development of lead-free perovskite thin films with adjustable optoelectronic properties is a highly discussed topic in materials science. In this study, we present the bending strain sensitivity of a lead-free hybrid organic-inorganic monodimensional iodide (TMSO)₃Sn_{3x}Bi_{2(1-x)}I₉ ($0 \leq x \leq 1$), with TMSO representing trimethylsulfoxonium. As previously observed in monodimensional haloplumbates, the insertion of Bi³⁺ results in the formation of vacant cation sites, which in turn leads to the adjustable shrinkage of the unit cell along the *a* lattice axis.^[1-3] Thin films, prepared by spin coating on flexible ITO/PET supports, are then employed to assess the bending strain sensitivity as a function of composition. The films produced with low amount or without Bi³⁺ show similar or worse piezoresistive properties than the ITO control, whereas when Bi³⁺ is the predominant metal ion, the corresponding piezoresistive features are enhanced (Fig. 1). An optimal composition is found in 75 % Bi, where the bandgap can be lowered down to 1.96 eV, and the gauge factor improves by increasing the bending strain, up to 110 at 0.6% strains.^[4] The films were analyzed by AFM to explain the observed features in terms of surface morphology. The microstructural and electrical properties after deformation were explored by SEM and EIS. This study represents an initial step in designing a lead-free halide perovskite with unique piezoresistive properties for bending sensors requiring sensitivity to small and high bending angles, applicable in soft robotics and wearable electronics.

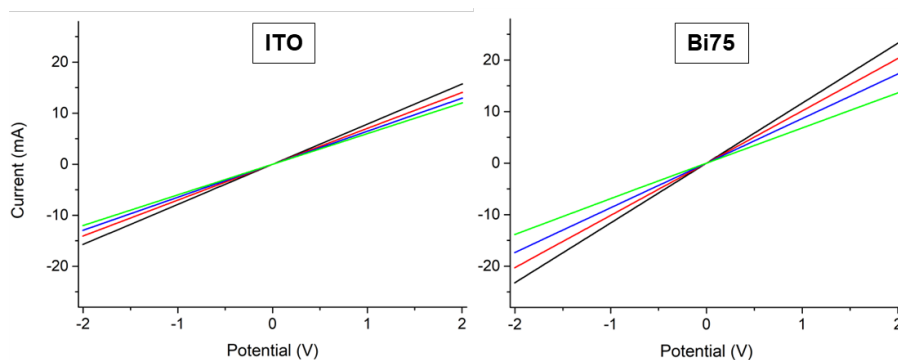


Figure 1: I-V curves of ITO control and sample 75 % Bi at different bending angles: 0° (black lines), 30° (red lines), 60° (blue lines), 90° (light green lines).

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