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Growth and characterization of CsPbBr3 single crystals

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Metal halide perovskites with APbX3 crystal structure show rapidly increasing global interest as a new generation of radiation detection materials alternative to CdZnTe. In this work, we present our results of the multiple single crystals growth of all-inorganic perovskite CsPbBr3 using Bridgman method. Crystals were prepared directly from CsBr and PbBr2 starting materials mixed with a various mole ratio. Our optimized growth process produces crystals with diameter 15 mm and length over 50 mm. We found that the quality of grown single crystals strongly depends on the purity of the starting materials, dropping speed of the growth ampule and cooling rate after growth. For characterization of transport properties of as-grown samples, we used pulsed I-V characteristics, Laser-induced transient current technique (L-TCT) at pulsed DC bias or Time-correlated single photon counting (TCSPC). We compared the crystallographic and transport properties of grown crystals depending on the change in the mole ratio of the starting materials, the change in the purity of the starting materials, different degrees of overheating, and different dropping speed of growth ampoule. In case of 1:1 stoichiometric ratio, 40 K overheating and dropping speed of 0.5 mm h-1, we have grown CsPbBr3 crystal with resistivity ρ=2.7·109 Ωcm evaluated from pulsed I-V characteristics. Pulse-biased L-TCT current waveforms show shorter hole lifetime at the center of the wafer than close in its border. The TCSPC signal indicates non single exponential decay with average rapid component of 0.5 ns.

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