Crystal growth and characterisation of organic-inorganic lead-free 2D double perovskite for application in radiation sensing

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Single crystals of lead-free organic-inorganic 2D $(BA)_2CsAgBiBr_7$ with double perovskite structure (monoclinic, $P2_1/m$) exhibit a significant potential for X-ray sensing [1]. This stems from their heavy elements constituting the perovskite octahedral network that is in an alternating arrangement with the barrier layer of organic BA^+ cations, consequently producing desirable electrical properties. In this study, several yellow-coloured single crystals of $(BA)_2CsAgBiBr_7$ were grown from a low-temperature solution [2]. All crystals are characterised by growth/dissolution features and defects (Figure 1). The phase purity and crystallinity of all samples have been verified from the powder XRD data. High ordering of Ag^+ and Bi^{3+} octahedra cations is apparent from the XRD patterns for single crystals, which depict peaks arising from the {001} plane.

Results from electrical characterisation of the single crystals of $(BA)_2CsAgBiBr_7$ reveal high resistivity (10^{11} Ωcm) and low density of trap states (10^{11}-10^{12} cm^{-3}), which are comparable to those published in literature [1]. This implies that the samples synthesised in this study also satisfy requirements for radiation sensors.

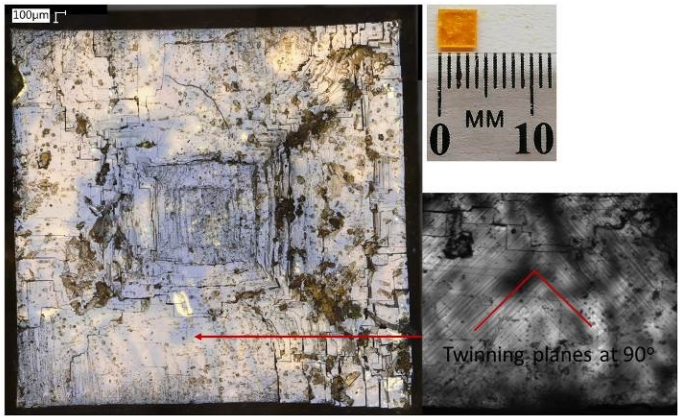

Figure 1. The top crystal surface of the sample $(BA)_2CsAgBiBr_7$_Exp1 (top right corner, 4 x 4 x 0.75 mm^3) is characterised by irregular growth /dissolution features (image on the left made in reflected light, 100 µm scale bar) and defects such as twinning planes at 90° (image on the right made in transmitted light).

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