Large-Sized Single Crystals of Layered Organic-Inorganic Hybrid Perovskite: Growth and Characterization

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Materials with a perfectly aligned lattice structure inherently offer the best performance for any applications. To understand completely the properties of materials, the development of growth techniques for large-sized single crystals is essential. However, it is always challenging to grow a large-sized single-crystalline material.

The layered organic-inorganic hybrid perovskite, in which organic layers (R) are included between the inorganic sheets of corner-sharing metal halide octahedral, have attracted attention due to the tunability in terms of being able to control the physical properties by replacing the organic groups (Figure 1). The number “n” denotes the thickness of perovskite sheets. Whereas the preparation and characterizations of large-sized single-crystals of non-layered organic-inorganic halide perovskite CH₃NH₃PbX₃ (n = ∞) have recently achieved,[1] the preparations and understanding of layered perovskite have not been well studied. In this respect, we envisioned that the fabrication of large-sized single crystals would give rise to the discovery of novel properties of layered organic-inorganic hybrid perovskite.

We succeeded in preparation of relatively large single crystals (ca. 4-5 mm, Figure 2) with 4-aminomethylpyridine as an organic component (R-NH₂). The absorption spectra of the crystals showed longer wavelength region as the number of layers “n” increased (Figure 3). The detail of the procedure of the preparation and properties of the crystals will be discussed.


Figure 1. Schematic representation of layered organic-inorganic hybrid perovskite.

Figure 2. Photograph of layered perovskite single crystals with n = 3 (left) and 4 (right). The minimum scale bar is 1 mm.

Figure 3. Absorption spectra of layered perovskite crystals with n = 1 (orange), 3 (red), 4 (blue), and 5 (black).