Benign-by-design solventless mechanochemical synthesis of 3-, 2- and 1-dimensional hybrid perovskites

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Introduction

Organic-inorganic hybrid perovskites have recently attracted significant attention in the scientific community due to their extraordinary optoelectronic properties with applications in the fields of solar energy, lighting, photodetectors and lasing. The rational design of these hybrid materials is a key factor to optimize their performance in perovskite-based devices. In this work, a mechanochemical approach is proposed as highly efficient, simple and reproducible methodology for the preparation of four types of hybrid perovskites obtaining large amounts of polycrystalline powders with high purity. The synthesis of two archetypal three-dimensional (3D) perovskites (MAPbI3 and FAPbI3) was accomplished, together with a bidimensional (2D) perovskite (GuaPbI3) and a “double-chain” perovskite (GuaiPbI4), whose structure has been elucidated for the first time by using X-ray diffraction.

Mechanosynthesis of hybrid Perovskites

X-ray Structural studies

Crystal structure of GuaPbI3

1D perovskite

NEW PEROVSKITE WAS BORN!!!

An excellent agreement could be observed between both patterns with no residual reflection peaks from any other concurrent structure.

Conclusion

In conclusion, the proposed mechanochemical synthesis offers a simple, efficient and highly reproducible approach for the design of advanced hybrid perovskites, including 3D, 2D and 1D materials. This solventless synthetic method is expected to pave the way for further discoveries and design of novel perovskite materials with innovative properties. Additionally, the facile and cost-efficient preparation of large quantities of the perovskite materials (i.e., 3-10 g per batch) remarkably simplifies their use in unexplored strategies for optoelectronics applications.

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References