Mechanosynthesis of the Hybrid Perovskite $CH_3NH_3PbI_3$: Characterization and the Corresponding Solar Cell Efficiency

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The increasing demand for clean energy has prompted researchers to intensively investigate environmentally friendly photovoltaic devices. The recent discovery of organo-metal halide perovskite crystals gave thin film photovoltaics a renaissance.[1] The diversity of the hybrid perovskites in composition and preparation makes them "excellent materials" with a unique combination of properties and potential for low cost and easy processing along with relatively high power conversion efficiency.[2] Crystallinity, density of defects and impurities are determining factors for (opto)electronic properties, and are also highly dependent on the materials formation processes for most inorganic semiconductors. Understanding this behavior and the structure/property relationship is crucial to a fundamental understanding of perovskite materials and to an eventual extension of their properties to other process-tolerant systems. In that context, the synthetic approach induced by mechanical forces has appeared as a new emerging methodology in materials science.[3] The mechanochemical reactions in solid state offer a significant advance by avoid the use of solvent, dramatically shortening synthesis times and simultaneously increasing the purity and amount of product. As a result, mechanosynthesis has been extensively applied as a 'green' method for the construction of discrete metal complexes, 1D coordination polymers and even porous 3D MOFs (metal organic-frameworks).[4]

Herein, we present a facile mechanochemical route for the preparation of hybrid $CH_3NH_3PbI_3$ perovskite particles with the size of several hundred nanometers for high-efficiency thin-film photovoltaics.[5] We also demonstrate that such approach applied for preparation of $CH_3NH_3PbI_3$ perovskite material has advantage over a solution-based synthetic routes in terms of device performance.

References

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