## GOTSolar

## Mechanosynthesis of the Hybrid Perovskite CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>: Characterization and the Corresponding Solar Cell Efficiency

D. Prochowicz,<sup>1</sup> M. Franckevičius,<sup>2,3</sup> A. M. Cieślak,<sup>1</sup> S. M. Zakeeruddin,<sup>2</sup> M. Grätzel<sup>2</sup>

and J. Lewiński<sup>1</sup>

<sup>1</sup> Institute of Physical Chemistry, Polish Academy of Sciences, Kasprzaka 44/52, 01-224 Warsaw, Poland

<sup>2</sup> Laboratory of Photonics and Interfaces, Institute of Chemical Sciences and Engineering, School of Basic Sciences, Ecole Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland.

<sup>3</sup> Center for Physical Sciences and Technology, Savanorių Ave. 231, LT-02300 Vilnius. dprochow@ichf.edu.pl

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.<sup>[1]</sup> 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.<sup>[2]</sup> 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.<sup>[3]</sup> 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).<sup>[4]</sup>

Herein, we present a facile mechanochemical route for the preparation of hybrid CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite particles with the size of several hundred nanometers for highefficiency thin-film photovoltaics.<sup>[5]</sup> We also demonstrate that such approach applied for preparation of CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite material has advantage over a solution-based synthetic routes in terms of device performance.

## References

- [1] M. Grätzel, Nat. Mater. 2014, 13, 838; (b) N.-G. Park, Mater. Today 2015, 18, 65.
- [2] W. S. Yang, J. H. Noh, N. J. Jeon, Y. C. Kim, S. Ryu, J. Seo, S. I. Seok, Science (2015), 348, 1234.
- [3] S. L. James et. al., Chem. Soc. Rev. (2012), 41, 413.
- [4] D. Prochowicz, I. Justyniak, A. Kornowicz, T. Kaczorowski, Z. Kaszkur, J. Lewiński, *Chem. Eur. J.* 2012, 18, 7367; (b) D. Prochowicz, K. Sokołowski, I. Justyniak, A. Kornowicz, D. Fairen-Jimenez, T. Friščić, J. Lewiński, *Chem. Commun.* 2015, 51, 4032.
- [5] D. Prochowicz, M. Franckevičius, A. M. Cieślak, S. M. Zakeeruddin, M. Grätzel, J. Lewiński, J. Mater. Chem. A 2015, 3, 20772.

This project has received funding from the European Union's Horizon 2020 research and innovation Programme under the grant agreement No 687008. The information and views set out in this presentation are those of the author(s) and do not necessarily reflect the official opinion of the European Union. Neither the European Union institutions and bodies nor any person acting on their behalf may be held responsible for the use which may be made of the information herein.



Funded by the Horizon 2020 Framework Programme of the European Union

CC BY NC ND

http://rcin.org.pl