Design and large scale production of 2D Materials for perovskite solar cells

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Herein we will discuss our latest developments towards the industrial-scale, reliable, inexpensive processes for the production of 2D materials [1] for energy conversion applications.[2] In particular, we will show how the production of 2D materials by solution processing[3] represents a simple and viable path towards the development of 2D material-based organic–inorganic halide perovskite solar cells (PSCs).[4,5,6,7,8,9,10]
Here, we will demonstrate how the so-called "graphene interface engineering" represents an effective tool to tune "on demand" the interface properties of PSCs (Figure 1).[4,5] In particular, we discuss how both the chemical functionalization and the hybridization of graphene and related materials are powerful tool to optimize the photovoltaic performances of PSCs. In fact, the design of 2D material-based active buffer layers[4,5,6,7] and charge transport layer additives[8,9] allow PSCs to achieve power conversion efficiencies (> 20%)[5] and stability (> 80% of initial performance after 500 h of continuous stress test).[6] These values competitive within the photovoltaic marketplace, targeted by industrial standards.

References

[1] A. E. Del Rio Castillo et. al., Material Horizons 5 (2018) 890
[2] F. Bonaccorso, et. al., Science, 347 (2015)1246501
[3] F. Bonaccorso, et al., Materials Today, 15 (2012) 564-589
[4] A. Capasso, et al. Advanced Energy Materials 6 (2016) 1600920.
[5] L. Najafi, et al. ACS Nano 12 (2018)10736
[6] G. Kakavelakis, al. Advanced Energy Materials 8 (2018) 1702287.
[7] A. Agresti, et al. ChemSusChem 9 (2016) 2609-2619.
[8] F. Bonaccorso, et al. Advanced Functional Materials 25 (2015) 3870-3880
[9] B. Taheri, et al. 2D Materials 5 (2018) 045034
[10] A. Agresti, et al. ACS Energy Letters 2 (2017) 279-287.

Figures

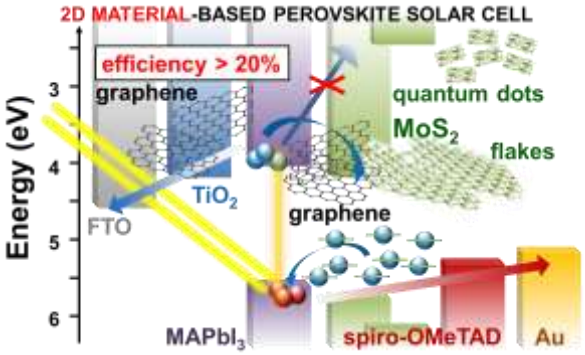

Figure 1: 2D material-based perovskite solar cells

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