

Department of Physics

Condensed Matter Physics

Clarendon Laboratory, Parks Road, Oxford OX1 3PU



CONDENSED MATTER SEMINAR

Thursday 15 November at 2.15pm

“Quantum-Dots-in-Perovskites: Solution-processed Heteroepitaxy for Optoelectronics”

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Solution-processed semiconductors have played a key role in advancing next-generation optoelectronics. Colloidal quantum dots (CQDs) are nanoparticles with tunable bandgap, high luminescence efficiency and solution processability. However, CQD thin films today still suffer a compromise between luminescence efficiency and charge transport, and this leads to unacceptably high power consumption.

Perovskites have been discovered with complementary features including excellent carrier transport properties that benefit from their low defect density, high mobility and long diffusion length. The first part of the talk will highlight our initiatives and efforts in marrying up these two materials by constructing a hetero-epitaxial junction between CQDs and perovskite [1]. The resulting novel solid material–quantum-dot-in-perovskite–shows superb photophysics properties benefiting from the interactions between the quantum dot and perovskite.

A variety of applications of the quantum dots in perovskites (QDIP) in optoelectronics will be presented in the talk, including 1) high performance solar cells [2], 2) light emission diodes [3], 3) photodetectors [4]. A 3D diffusion-quenching-model was developed based on quantum dots in perovskite single crystals. This model enables the accurate measurements of the diffusion length, mobility, and trap densities of perovskite single crystals [5].

References:

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- [2] Z. Yang, A. Janmohamed, X. Lan, F. P. García de Arquer, O. Voznyy, E. Yassitepe, G.-H. Kim, Z. Ning, X. Gong, R. Comin, E. H. Sargent, *Nano Lett.* 2015, 15, 7539.
- [3] X. Gong*, Z. Yang*, G. Walters, R. Comin, Z. Ning, E. Beauregard, V. Adinolfi, O. Voznyy, E. H. Sargent, *Nat. Photonics* 2016, 10, 253.
- [4] F. P. García de Arquer*, X. Gong*, R. P. Sabatini, M. Liu, G.-H. Kim, B. R. Sutherland, O. Voznyy, J. Xu, Y. Pang, S. Hoogland, D. Sinton, E. Sargent, *Nat. Commun.* 2017, 8, 14757.
- [5] X. Gong, R. Sabatini, Z. Huang, C.-S. T. Tan, G. Bappi, G. Walters, A. Proppe, O. Voznyy, S. Kelley, E. Sargent, Unpublished results.
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Host: Prof Thorsten Hesjedal

Audrey Wood Seminar Room, Clarendon Laboratory