Department of Physics
Condensed Matter Physics
Clarendon Laboratory, Parks Road, Oxford OX1 3PU

UNIVERSITY OF OXFORD

CONDENSED MATTER SEMINAR

Thursday 22 February at 14:30
Simpkins Lee room

"Photothermal Spectroscopy in Studies of Optoelectronic Materials"

Dr. Szymon J. Zelewski [1,2]
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2 Cavendish Laboratory & Department of Chemical Engineering & Biotechnology, University of Cambridge, UK

The comprehensive development of new optoelectronic materials and structures strongly depends on the ability to determine the underlying fundamental mechanisms responsible for the improvement of device performance. Studies of electronic disorder in the active absorber layers in photovoltaic cells have been proven to be a good predictor of the open-circuit voltage deficit and, consequently, the power conversion efficiency, and a similar correlation can be proposed for light-emitting diodes. The Urbach energy is a quantitative measure of the electronic disorder and represents the sharpness of the semiconductor absorption edge, though its experimental determination is often challenging due to the high measurement sensitivity required for accurate assessment of the sub-band-gap absorbance. My talk will cover the physical fundamentals of photothermal deflection spectroscopy (PDS), a state-of-the-art method for non-contact measurements of optical absorption coefficient across several orders of magnitude. Its unique advantages make it an attractive tool for characterising emerging optoelectronic materials, regardless of their morphology, light scattering, or thickness and preparation method. I will present recent results linking the final device structure performance with the Urbach energy and sub-gap defect-related absorption obtained from PDS spectra, along with challenges arising from device-level characterisation. Recent developments in modelling absolute absorption coefficient based on the theoretical model for PDS signal generation, including thermal transport properties will make another highlight. In a broader context, I will showcase the main characteristics of photothermal methods, all offering a unique combination of optical spectroscopy and calorimetry which enabled recent breakthroughs in the field of nanoscale thermal transport.

Host: Dr. Krishanu Dey