MESTRADO EM FÍSICA
(Perfis: Física Fundamental e Física Aplicada)

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Proposta de tese

Título/Tema: Nanostructured Architectures for Colloidal Quantum Dot Solar Cells.

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Objetivos: To decouple absorption from carrier collection in QD solar cells by introducing a nanostructured device architecture in order to improve the photocurrent and the power conversion efficiency of colloidal QD solar cells.

Resumo: Colloidal quantum dots are solution-born nanocrystals that can be tuned by quantum confinement to absorb and emit light efficiently at a wide range of wavelengths (e.g., to match the solar spectrum), making them a promising active-layer candidate for next-generation solar cells and other optoelectronic devices such as light-emitting diodes. Despite rapid advances in performance, however, modern QD solar cells remain limited by a fundamental trade-off between light absorption and photo-carrier collection due to poor electronic transport. Vertically aligned arrays of ZnO nanowires can decouple absorption and collection: The nanowires penetrate into the QD film and serve as highly-conductive channels for extracting photogenerated electrons from deep within the film. After optimizing the nanowire growth and device fabrication processes, it is reported that incorporating nanowires boosts the photocurrent and the efficiency of planar QD photovoltaic devices by 50% and 35%, respectively. Synthesising ZnO nanowires and fabricating ordered bulk heterojunction QD devices incorporating Lead sulphide (PbS) QDs, which are particularly well suited for solar energy conversion, with an absorption edge tuneable from the near-infrared through the visible and stability in ambient atmosphere, this thesis will introduce a novel ordered bulk heterojunction architecture for colloidal quantum dot (QD) solar cells.

Ref: Quantum Dot Solar Cells. *The Next Big Thing* in Photovoltaics, P.V.Kamat, *J. Phys. Chem. Lett.*, **2013**, *4* (6), pp 908-918