Dynamics of Energy Transfer in Perovskite Nanostructures for Optoelectronic Applications

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Nanomaterials are emerging as important components in many optoelectronic devices such as solar cells, LEDs, and photodetectors. Although their small size makes them attractive from an engineering standpoint, there are significant challenges in working with nanoscale semiconductors: optoelectronic properties change due to confinement effects that can restrict charge movement, and surface states can act as electron traps.[1] One strategy to counteract these effects is to design energy transfer pathways by combining nanomaterials into heterostructures, where the flow of energy can be intimately controlled.

This project will investigate energy transfer processes in a range of heterostructures built from layered hybrid metal halide perovskites, an exceptional class of materials that in thin-film form is already attractive for solar energy applications.[2-3] However, in perovskite nanomaterials the presence of additional interfaces can provide extra locations for energy loss, sometimes at rates that are detrimental to device performance. Here, the rates of different energy transfer processes within and between the different materials of a heterostructure will be studied on multiple timescales, from the femtosecond to the millisecond range, in order to better understand the intrinsic and extrinsic optoelectronic performance of these new materials.

This experimental PhD project will use ultrafast spectroscopy techniques including optical-pump/THz probe spectroscopy, a non-contact optical technique with proven success in studying the optoelectronic properties relevant for device applications.[4] The project will utilize many of the advanced spectroscopy and microscopy capabilities at the university, including the resources of the Warwick Centre for Ultrafast Spectroscopy (go.warwick.ac.uk/WCUS).

More information about the group's recent research activities can be seen on our web page at go.warwick.ac.uk/ultrafast. Informal enquiries can be directed to Dr Milot at rebecca.milot@warwick.ac.uk.

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