BRISTOL CENTRE FOR FUNCTIONAL NANOMATERIALS

University of BRISTOL

Bristol – JILIN Symposium: October 2018

Abstract Submission Form

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Brief description of research activities:

The Oliver group uses ultrafast techniques to explore photochemical and photophysical phenomena in a wide variety of biological, chemical and nanomaterial systems. This ranges from the initial electronic energy transfer steps in light harvesting inside pigment-protein complexes of plants, the role of polarons in photovoltaic films to photoinduced membrane re-organisation in living leaves. To perform these studies, the group uses established techniques such as transient absorption spectroscopy, time-correlated single photocounting, but is also actively developing new multidimensional optical spectroscopic techniques which afford high temporal and spectral resolution.

Presentation title:

Exploring pigment-protein interactions using ultrafast laser spectroscopy

Presentation abstract:

Photosynthetic organisms harness energy from sunlight to power most biological activity on Earth. Light is absorbed by chlorophyll and carotenoids molecules inside antenna proteins such as light harvesting complex II in higher plants. Energy is transferred between molecules in a cascade of ultrafast (femtosecond to picosecond (1×10^{-15}– $1\text{x}10^{-12}$ s timescales) electronic energy transfer (EET) events inside individual proteins to reaction centres and initiates critical charge separation. The encapsulating protein plays several pivotal roles in photosynthetic EET, however, an understanding of the specific molecular interactions between the encapsulated chromophore and immediate surrounding protein that underpin this role have yet to be fully elucidated. Using ultrafast pump-probe spectroscopy we have initiated a series of investigations to understand the critical pigment-protein interactions in specially designed *de novo* proteins that contain individual light harvesting pigments and the direct affect on the photophysical properties.

Selected publications:

1) Surface functionalization significantly changes the physical and electronic properties of carbon nano-dots
T.A. Swift, M. Duchi, S.A. Hill, D. Benito-Alifonso, R.L. Harniman, S. Sheikh, S.A. Davis, A.M. Seddon, H.M. Whitney, M.C. Galan and T.A.A. Oliver, *Nanoscale*, **10**, 13908-13912 (2018).

2) Investigating the role of the organic cation in formamidinium lead iodide perovskite using ultrafast spectroscopy
V.C.A. Taylor, D. Tiwari, M. Duchi, P.M. Donaldson, I.P. Clark, D.J. Fermin and T.A.A. Oliver, *J. Phys. Chem. Lett*, **9**, 895-901 (2018).

3) Recent advances in multidimensional optical spectroscopy
T.A.A. Oliver, *R. Soc. Open Sci.* Invited Review, **5**, 171425 (2018).

4) Correlating the motion of electrons and nuclei with two-dimensional electronic–vibrational spectroscopy, T.A.A. Oliver, N.H.C. Lewis and G.R. Fleming, *Proc. Natl. Acad. Sci. USA* **111**, 10061-10066 (2014).