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Scanning Near-Field Electroluminescence: a new tool to measure solid-state light emission

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From light-emitting diodes (LEDs) to solar cells, there is a large demand for developing new materials towards more efficient, cost-effective and sustainable optoelectronic devices. [1] Critical to all of these devices is an extensive knowledge on exciton photo-generation and carrier recombination processes. Electroluminescence (EL) imaging is a well-established tool that can used to evaluate the exciton diffusivity [2] on the surface of a device with micrometric resolution. To date, submicron resolution EL imaging is accomplished primarily with the assistance of scanning tunneling microscopy (STM) [3]. However, controversies on the genuineness of EL signal from STM based methods exist, as this has been often attributed to field emission [4]. In this presentation, we present scanning near-field electroluminescence (SNEL) imaging a novel analytical technique developed in our lab, in which EL is recorded in through an aperture-type scanning near-field optical microscope (SNOM) coupled with additional light excitation and AC external bias. The submicron resolution of SNOM is anticipated to be essential to capture the EL signal, as well as the local sample morphology. Preliminary experiments with organic EL devices of P3HT (poly(3-hexylthiophene-2,5 diyl) and PCBM ([6,6]-Phenyl C61 butyric acid methyl ester) with graphene top electrode have been imaged, demonstrating the specific conditions in which genuine EL can be decoupled from field-emission.

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Authors: Prof. FANCHINI, Giovanni (Department of Physics and Astronomy, University of Western Ontario, London, ON, Canada); Mr WONG, Victor (Department of Physics and Astronomy, University of Western Ontario, London, ON, Canada)

Co-authors: Dr HUI, Bertha (Department of Engineering Physics, McMaster University, Hamilton, ON, Canada); Mr MUNIR, Muhammad (Department of Engineering Physics, McMaster University, Hamilton, ON, Canada); Prof. TURAK, Ayse (Department of Engineering Physics, McMaster University, Hamilton, ON, Canada)

Presenter: Mr WONG, Victor (Department of Physics and Astronomy, University of Western Ontario, London, ON, Canada)

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