MONASH University

Monash Centre for Electron Microscopy

Seminar

Time-resolved Cathodoluminescencefrom lifetime measurements to pump-probe luminescence

Wednesday 26th February, 2020

11.00am

Lecture Theatre S9
16 Rainforest Walk, Clayton Campus

Dr Sophie Meuret

Researcher in the CEMES Laboratory (CNRS) in Toulouse. Before that she was a Post Doc in the Photonic Materials Group at AMOLF, Amsterdam. She obtained her PHD from the University Paris, Saclay.

Abstract

Cathodoluminescence has become one of the most powerful technique to study the optical properties of nanostructures at the nanoscale. With the development of a pulsed electron beam, it is now possible to access dynamical information. In the case of nanophotonic structures, time-resolved cathodoluminescence [1] has significantly broaden the accessible optical properties, reaching an almost full characterization of their emission properties at the nanoscale. For example, it is able to measure the lifetime of excited states [2] or the speed of the diffusion of charge carriers[3]. However, we are still unable to assess the influence of electron excitation on the nanostructure optical properties or to measure the local absorption properties of light. In this presentation we will show that pump-probe luminescence experiment has allow us to go beyond standard time-resolved cathodoluminescence measurement. In pump-probe luminescence, a pulsed electron beam and a pulsed laser beam excite the sample with a controlled delay between the two excitations, and we collect both the cathodoluminescence and photoluminescence signals. In a pump-probe experiment, we observed the relative change of the luminescence spectrum when both light and electrons illuminate the sample compared to when only one or the other is present. We will show how, thanks to this experiment, we can measure, at the nanoscale, the effect of electron interaction on the optical material properties (quenching or enhancement)[4] and the local light absorption properties. We will also discuss how the measurement of the autocorrelation function of the cathodoluminescence g(2)(τ) reveals electron excitation mechanisms and help measuring the excitation probability without prior knowledge of the sample geometry..

The Presenter

Sophie Meuret is a researcher in the CEMES Laboratory (CNRS) in Toulouse since December 2018, where she is studying the complementarity of electron holography and cathodoluminescence in a TEM. Before she was a Post-Doc in the Photonic Materials group at AMOLF, Amsterdam. She obtained her PhD from the University Paris Saclay. Her work mostly focuses on the understanding of electron-matter interaction using cathodoluminescence (CL) spectroscopy. One of her main axe of research is the use of Hanbury Brown and Twiss interferometer, to studied the CL autocorrelation function g(2) from semiconductors. The g(2) shows strong bunching due to the fact that a single electron creates multiple excitations. She showed that this effect can be used to extract the excitation efficiency without a priori knowledge of the structure as well as the lifetime. During her post-doc she was developing ultra-fast time-resolved cathodoluminescence spectroscopy to study spatially-resolved ultrafast carrier recombination and single emitters in nanostructures. In parallel, she developed, together with Magda Solà Garcia (PhD), a time-resolved microscope based on a pulsed-laser driven electron gun with cathodoluminescence. This geometry allows pump-probe CL spectroscopy on a wide range of nanophotonic structures.

CORONOVIRUS WARNING:

All people who have been in mainland China (excluding Hong Kong, Macau and Taiwan) must self-isolate if they were in mainland China on or after 1 February 2020.

If a person who has been in mainland China on or after 1 February 2020 begins to feel unwell and develop shortness of breath, a cough or respiratory illness during the 14 days since they were last in mainland China, they should seek medical attention by calling ahead to their GP or emergency department and mentioning recent travel to mainland China.

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Visitors are most welcome. Monash University Clayton campus map can be found at: http://www.monash.edu.au/pubs/maps/3-Claytoncolour.pdf. Please note the parking arrangements. There is a designated Visitors Car Park (N1) clearly ground-marked by white paint and tickets are available from a dispensing machine