

Deconvolution microscopy reveals exciton spatial distribution in STM-induced luminescence of 2D semiconductors

Eric Le Moal¹

Elysé Laurent¹, Ricardo Javier Peña Román², Sarah Miller¹, Aditi Raman Moghe³, Etienne Lorchat⁴, Séverine Le Moal¹, Elizabeth Boer-Duchemin¹, Luiz Fernando Zagonel², Stéphane Berciaud³

¹Université Paris-Saclay, CNRS, Institut des Sciences Moléculaires d'Orsay, Orsay, France

²Institute of Physics "Gleb Wataghin", State University of Campinas-UNICAMP, Campinas, Brazil

³Institut de Physique et de Chimie des Matériaux de Strasbourg, Université de Strasbourg, CNRS, Strasbourg, France

⁴NTT Research, Inc., Physics & Informatics (PHI) Laboratories, Sunnyvale, CA 94085, USA

eric.le-moal@universite-paris-saclay.fr

The diffusion of charge carriers and excitons (bound electron-hole pairs) and their interactions with defects play a key role in the electroluminescence properties of two-dimensional (2D) semiconductors. Understanding and controlling these processes is crucial for the performance of future devices based on these materials. Recently, the electroluminescence properties of monolayer transition metal dichalcogenides (TMDs) have been mapped at the nanoscale by recording light induced by the tunnelling current under the tip of a scanning tunnelling microscope (STM) scanned over the sample [1-4]. However, such techniques provide no information on the diffusion of charge carriers and excitons, as they are not sensitive to the spatial distribution of emission around the excitation source. To address this issue, we combine tunnelling current excitation under the tip of an STM (for extremely local excitation), wide-field optical microscopy (to image the spatial distribution of the emission), and deconvolution of optical microscopy images using an iterative Richardson-Lucy algorithm (to achieve spatial resolution beyond the diffraction limit) [5].

References

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Figures

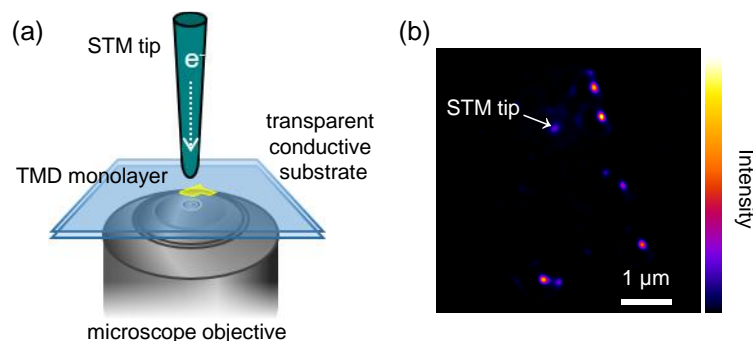


Figure 1: (a) Schematic of the experiment, combining an STM head and an inverted optical microscope. (b) Deconvolved optical microscopy image of the STM-induced luminescence of a WS₂ monolayer, showing the emission of hot spots several micrometres away from the STM tip [5].