STS and STML as tools to study individual defects in TMDs

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Abstract

The study of individual defects in Transition metal Dichalcogenides (TMDs) at the relevant scale (atomic or nanometric scales) continues to be a challenge to which scanning probe microscopes can be an interesting solution. Besides the imaging capabilities of the Scanning Tunnelling Microscope (STM), the following associated techniques can be very useful in the study of single defects in TMDs: in one hand, Scanning Tunnelling Spectroscopy (STS) can give a good idea of the local bandgap and local density of states (LDOS) around defect sites, while in the other hand the light emitted by the sample due the tunnelling current, called STM induced Luminescence (STML), is a way to directly measure the light emission by locally exciting a small region, like a defect. [1,2]

We report on a novel light detection scheme which aims to be highly efficient and yet compatible with an ultra-high vacuum, low-temperature STM. Our light detector uses a small mirror accurately positioned with a 3-axis piezo nano-manipulator. Supposing an isotropic semi-spherical light source, light ray optical numerical simulations predict about 70% collection efficiency, similarly to patented solutions.[3] We aim to apply this facility to the study of two-dimensional (2D) materials like TMDs such as MoS_2 and WS_2 and WSe_2. These materials are receiving extensive relevance due to their great and tuneable optical properties.[4] Particularly, the properties of these materials can be further tailored by defect engineering, including on-purpose added point defects in monolayers.[5] We will present the first results obtained with our systems and expected direction of this project.

References

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