

Near-field investigation of the electromagnetic local density of states

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Abstract

The local density of electromagnetic states (EM-LDOS) is a quantity of fundamental interest which governs the spontaneous decay rate of dipole emitters in an environment, or the thermal emission from the surface of materials [1, 2]. As illustrated in figure 1, experiments have demonstrated the ability of scattering near-field scanning optical microscopy to image the near-field thermal emission [3], and to measure its spectrum with nanoscale resolution in the mid-infrared with heated tips [4], or with a hot sample holder [4-6], which allows one to probe the EM-LDOS in this range of the electromagnetic spectrum. We will mainly discuss the application of the method of thermal radiation scanning tunnelling microscopy (TRSTM) to investigate materials supporting surface plasmon and surface phonon polaritons. We will show that it is capable to produce undistorted super-resolved images at large scales, even on rough surfaces with a lot of scattering centers [7].

We will also briefly discuss the recent development of near-field scanning probes of the EM-LDOS in the visible range, using a fluorescent nano-object grafted at the extremity of the tip of an atomic force microscope [8,9], and the ability of the method to separate the radiative and the apparent non-radiative EM-LDOS in the near-field of a metallic nano-antenna [9].

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Figures

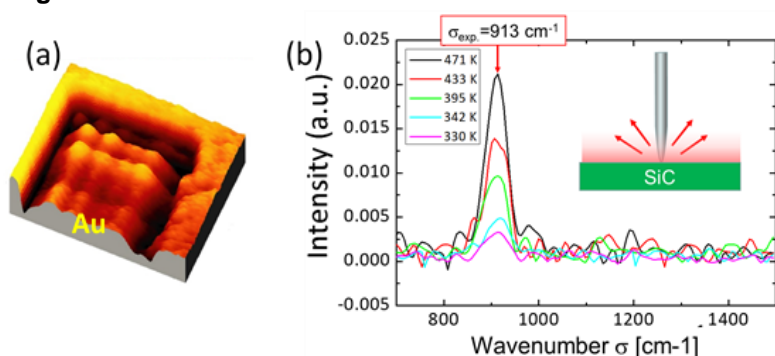


Figure 1: Image and spectra of the near-field thermal emission obtained with a TRSTM on materials supporting surface polaritons [3,5,6].