**Real-space cathodoluminescence imaging of silver nanowaveguides**

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To fully harness the precise control of light at the nanoscale with nanophotonic and nanoplasmonic structures a new generation of advanced methods is required to interrogate the position, angle and energy of light emission at the nanoscale. Optical methods are limited in the excitation probe size and the spatial resolution of the real-space image (both approximately 0.5 - 1 $\mu$m). Furthermore, light must be coupled into the nanoscale system, restricting possibilities for the position of the excitation [1]. Cathodoluminescence (CL) in the scanning electron microscope (SEM) has been demonstrated to be an excellent nanoscale probe of nanophotonic devices and materials [2]. The focused electron probe acts as a local electromagnetic field that excites both travelling waves and resonant modes in nanoscale light-controlling systems. By scanning the electron probe, maps of the optical excitability can be generated, showing the resonant energy and direction of emission at each excitation point [2]. In general, the point of emission is not detected.

Here we demonstrate a new mode of real-space CL imaging realized in a Correlative Light Electron Microscope (CLEM - specifically a DELMIC SECOM installed on a Thermo Fisher Verios 460) [3]. The nanometer-sized electron probe is scanned along the wire with nanometer step size, exciting a travelling plasmon wave which couples to the far field at the wire ends. A full-field, real-space image of the light emission is taken from underneath the transparent substrate with a high numerical aperture optical microscope. From a plot of the light emission intensity from the wire ends as a function of the probe position, the plasmon propagation length can be efficiently determined for multiple chemically grown silver nanowires. This method has many distinct advantages over measurement with an optical microscope. The electron probe can excite plasmons at any point, unlike light which can only couple into the nanoscale system at ends or defects. Multiple unique and defective nanowires can be examined and results can be correlated to high-resolution SEM images. In conjunction with spectroscopy and angle-resolved CL imaging [2], a full understanding of excitability and emission in nanoscopic optical materials can be obtained.

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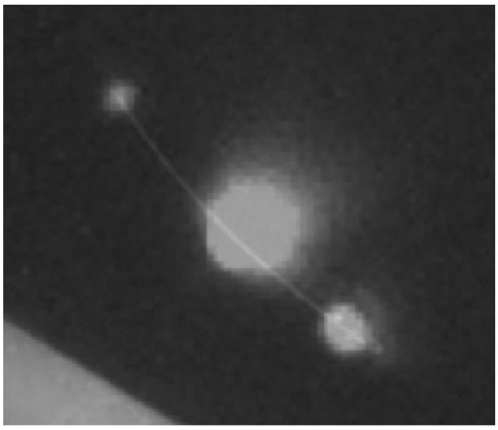
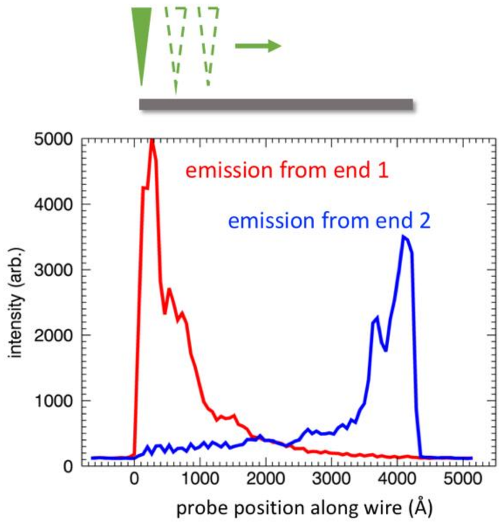


**A** Real-space optical image showing light emission from wire ends superimposed on a high-resolution SEM image of the silver nanowire




**B** Light emission from wire ends as a function of probe position