Electron Beam Excitation of Plasmonic Modes in Gold Dimers

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Abstract: We report on the first realization of hyperspectral imaging for visualization and excitation of plasmon modes in dimers of 100 nm gold decahedra by a scanning electron beam.

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We report on the first realization of a hyperspectral imaging (HSI) technique of surface plasmon polaritons excited in metallic nanostructures by a scanning electron beam. The HSI image is formed by scanning a plasmonic structure with a focused electron beam, simultaneously recording the spectra of light emission from decoupled plasmons by a spectrum analyzer, resulting in a hyperspectral data cube consisting of the spatial coordinates of electron beam and the corresponding plasmon emission spectra.

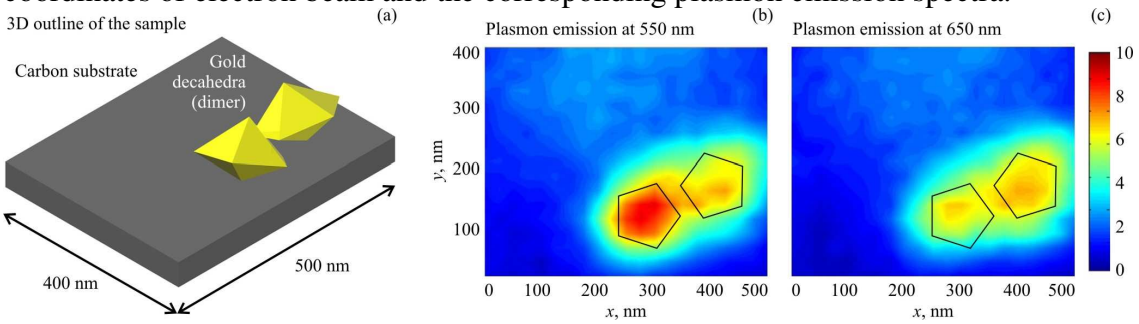

Fig. 1. Electron beam excitation of plasmons in the dimer (a), consisting of two 100 nm gold decahedra separated by 20 nm. Asymmetric (b) and symmetric (c) modes are found at 550 and 650 nm, respectively.

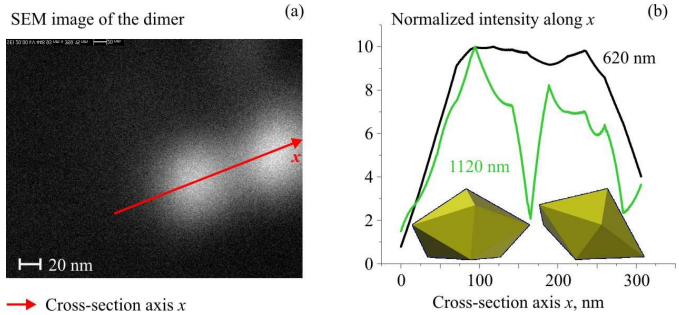

Fig. 2. Intensity distribution along the axis of the dimer (a), illustrating the hybridization mode at 620 nm, at which the nanoparticles collectively act as a dipole, and the separated mode at 1120 nm, in which they act as separate entities (b).

We performed plasmonic HSI on a dimer [1] consisting of two gold 100 nm decahedra on a carbon substrate (Fig. 1). The plasmonic modes of the dimer were visualized, and we identify the electron beam excitation of symmetric, asymmetric and hybridization modes (Fig. 2). The demonstrated technique can be used in single-scan examination of plasmonic nanostructures with the resolution of a scanning electron microscope. It has all advantages of plasmon generation by free electron injection [2], such as fast repositioning and a high localization and intensity of the plasmon source.

References

[1] I. Romero, J. Aizpurua, G. W. Bryant, F. J. García de Abajo, Optics Express **14**, 9988 (2006).
[2] M. V. Bashevoy *et al.*, Nano Letters **6**, 1113 (2006); J. T. van Wijngaarden *et al.*, Appl. Phys. Lett. **88**, 221111 (2006).