Visualization of Multipolar Longitudinal and Transversal Surface Plasmon Modes in Nanowire Dimers

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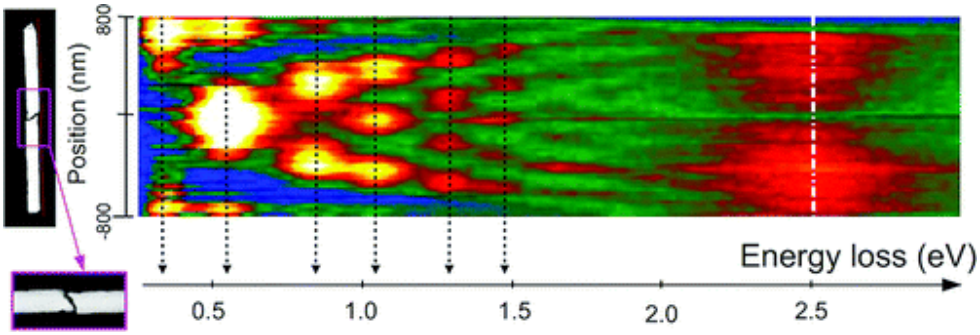

We study the transversal and longitudinal localized surface plasmon resonances in single nanowires and nanowire dimers excited by the fast traveling electron beam in a transmission electron microscope equipped with high-resolution electron energy-loss spectroscopy. Bright and dark longitudinal modes up to the fifth order are resolved on individual metallic nanowires. On nanowire dimers, mode splitting into bonding and antibonding is measured up to the third order for several dimers with various aspect ratio and controlled gap size. We observe that the electric field maxima of the bonding modes are shifted toward the gap, while the electric field maxima of the antibonding modes are shifted toward the dimer ends. Finally, we observe that the transversal mode is not detected in the region of the dimer gap and decays away from the rod more rapidly than the longitudinal modes.