High Resolution Energy Loss Spectroscopy of Plasmonic Hybridization in Silver Nanostructures

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In this contribution we highlight systematic studies of the plasmonic response of nanostructure that exhibit hybridization effects. The structures are produced using electron beam lithography and are designed with increasingly complex morphologies. The structures are subsequently characterized with electron energy loss spectroscopy using a Titan 80-300 TEM equipped with a monochromator achieving an energy resolution of 80meV (or better). Using numerical deconvolution we achieve an effective resolution of 40meV and can observe resonances in the range of 0.2-0.3eV energy loss, corresponding to the mid-infrared part of the electromagnetic spectrum. The observations highlight the coupling of the nanostructures and strong enhancements due to the interactions between the nanostructures. We also demonstrate the detection of very low energy hybridization modes extending over large areas and very small energy splitting between the hybridization modes. This work is then compared with theoretical calculations to identify the modes and the hybridization levels. The prospects of using these complex structures to tune the plasmon response function are discussed.