Plasmonic Nanocrystals for energy-saving smart windows

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Doped semiconductor nanocrystals are an emerging class of materials hosting localized surface plasmon resonance (LSPR). Their wide spectral range (from visible to the entire IR regions) and post-synthetic tunability through doping promise new plasmon-assisted active optical materials and devices. Recent studies discovered different semiconductor species that perform efficient LSPR. However, the nanocrystals' structural impact on their LSPR remain poorly explored.

In this presentation, we illustrate how the structural factors collaborate to exhibit novel LSPR properties that are unseen from metal hosts. For instance, in hexagonal cesium-doped tungsten oxide (Cs_xWO_{3-y}) nanocrystals, the crystalline anisotropy causes a strong LSPR band-splitting into two distinct and intense peaks. This finding highlights that multiple structural factors can be controlled to create and exquisitely tune the multimodal LSPR bands from semiconductors. We also show the rapid and reversible modulation of LSPR by chemical and electrochemical charging/discharging of carriers in the plasmonic semiconductor nanocrystals, which is applicable to sensors and electrochromic smart windows.