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Multiple sharp lattice plasmon modes in 2D Au nanoparticle superlattices DANQING WANG, ANKUN YANG, ALEXANDER HRYN, GEORGE SCHATZ, TERI ODOM, Northwestern Univ, ODOM GROUP TEAM — Periodic metal-nanoparticle (NP) 1D chains and 2D arrays can produce sharp lattice plasmon modes due to the coupling between the diffraction mode of the periodic lattice and the localized surface plasmon resonance of the metal NPs. 2D Au NP superlattices, new structures that combine multiple length scales, have the potential for new optical properties such as mode coupling. They differ from periodic 2D arrays in that the spacing between NP patches introduces an additional microscale patch periodicity while the sub-microscale NP periodicity is maintained within one patch. In the reciprocal space, the small periodicity corresponds to a large wavevector while the large periodicity corresponds to a small one. For 2D NP superlattices, the two wavevectors sum together and show additional, satellite diffraction modes at higher and lower energies than the modes for periodic 2D arrays. We found that multiple sharp lattice plasmon modes exist in the 2D Au NP superlattices as the satellite diffraction modes couple with the localized surface plasmon mode. Multiple peaks with narrow linewidths in the transmission spectrum were observed in both numerical calculations and experiments. 2D Au NP superlattices provide flexibility in tuning the lattice plasmon mode through changing the microscale periodicity of the patches. The multiple sharp lattice plasmon modes can also serve as potential cavity modes for surface-emitting lasing.

Danqing Wang
Northwestern Univ

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