Plasmonic Metastructures Based on Epitaxial Metallic Materials

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Epitaxy is a type of crystal growth method, in which crystalline layers are formed with well-defined orientations with respect to the similar or dissimilar crystalline structures of substrates (*i.e.*, wafers). In photonic and optoelectronic device applications, such as light-emitting diodes, lasers, and single-photon emitters, semiconductor heterostructures (quantum wells, nanorods, and quantum dots) formed by epitaxy have been widely deployed as the device building blocks. In comparison, metal nanostructures used for plasmonic applications are typically made via less-demanding material deposition methods. Recently, we have found dramatically improved material properties and performance obtained by using crystalline metallic films grown by molecular-beam epitaxy (MBE) under ultrahigh vacuum (UHV) conditions. Especially, in this talk, I will highlight the recent results of plasmonic metasurfaces and surface-enhance Raman spectroscopy (SERS) substrates based on MBE-grown epitaxial films, including aluminum (Al) and titanium nitride (TiN). Due to their superior performance, these epitaxial plasmonic materials can play a key role for demanding plasmonic applications.