Interface Modes at Tensorial Metal-Dielectric Hybrid Materials

Ralf Vogelgesang

Max Planck Institut for Solid State Research, Stuttgart, Germany

When radiation propagates through materials, one usually only distinguishes dielectric from metallic materials. The former transmit radiation and the latter prohibit it. At the interface between a dielectric and a metallic medium there often exist specific modes of radiation, which are free to propagate along the interface, and are bound in the normal direction, decaying exponentially in either medium. Specifically, the vibrantly growing field of (surface) plasmonics is based entirely on this phenomenon.

Anisotropy – that is, material responses to electromagnetic field components that depend on direction – has played so far only a minor role in the study of interface modes. Even though many useful devices like polarization rotators, modulators, isolators, etc. are based on volume anisotropy, it is usually only a minor contribution on top of nearly isotropic behavior. This view might have to be changed by the recent proliferation of materials that exhibit much more drastic anisotropy.

In particular, certain classes of layered media may indeed exhibit both metallic and dielectric behavior at the same time, but in different directions. These metal-dielectric hybrid materials offer many opportunities for novel effects. Some of these I will highlight in my presentation: For interface modes they imply a considerably richer mode structure. Modified conditions must be established for their presence in the first place. The field structure at the interface is more complicated than that of conventional interfaces plasmons at the surface of Drude-metals. In general there will be multiple dispersion relations, etc. It is quite conceivable that devices will be developed based on these anisotropic interface modes with functionalities similar to those based on volume anisotropy.