Chapter 68

Multi-resonant Metamaterials for Visible and Near-IR Frequencies

Nicholas Sharac, O. J. Glembocki, A. Giles, J. D. Caldwell, and S. M. Prokes

Abstract At low frequencies, metals behave as a perfect electric conducting (PEC) material and no longer exhibit plasmonic properties. By “spoofing” a metal, through the use of grooves or perforations, with feature sizes much smaller than the incident wavelength, metals can have an effective dielectric that allows plasmonic responses even in ranges outside the optical range. Additionally, while on a smooth metal film, surface plasmons will propagate along the surface, a patterned film can have localized plasmon resonance, as in the case of PEALD Ag, which has small gaps. Thus, spoof hybrid plasmonics can occur (a) in large conformal coatings (b) can allow for multi mode transmission, and (c) allow for both traveling and localized modes. Here, we explore the effects of randomness in ALD Ag, and also modify the optical response in metamaterial structures by changing the unit cell. This is explored using reflectance measurements and calculations, including band structure. This research has applications in energy harvesting, communications, and sensing.

References

1. Benson, (2011). *Nature*, 480, 193.
2. Sigma Aldrich, sigmaaldrich.com. Accessed July 2015.
3. Surface Plasmon Polaritons. <http://large.stanford.edu/courses/2007/ap272/white1/>. Justin White. Accessed July 2015.
4. Hammond et al. (2014). *Biosensors*, 4, 172–188.
5. Pendry J. B. et al. (2004). *Science*, 305, 847.
6. Mousavi et al. S. H. (2010). *PRL*, 105, 176803.

N. Sharac (✉) • O.J. Glembocki • A. Giles • J.D. Caldwell • S.M. Prokes
Electronics Science and Technology Division, U.S. Naval Research Laboratory,
Washington, DC, USA
e-mail: nicholas.sharac.ctr@nrl.navy.mil