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Quest for zero loss: the materials selection problem in plasmonics

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Under specific conditions incoming light can excite a wavelike oscillatory resonance in the free electrons of a conducting material. When this oscillation propagates along a surface it is usually termed a surface plasmon polariton; when confined to a discrete nanoparticle as a standing wave it is more correctly termed a localised surface plasmon resonance (LSPR). There is currently considerable interest in 'plasmonics'- the study of both kinds of plasmon- because applications as diverse as biosensors, optical computing, rectenna arrays, and metamaterials can make use of them. The strength of the plasmon resonance that can be excited depends on the geometric shape of the structure and, most importantly, its dielectric function at the wavelength of interest. The dielectric function, in turn, depends directly upon the electronic density-of-states of the relevant material. Here we consider how the dielectric function can be optimised for a desired type of plasmon resonance by selection of a suitable material. The metallic elements Au and Ag are well known material choices for these applications, Al and Cu are also possibilities, while Na and K have very suitable dielectric functions but rather unfavourable chemical properties. There are additional possibilities offered by alloying or compound formation and we present examples drawn from our own work on the Ag-Au, Cu-Au, Al-Au, Al-Pt, Au-Ni and Cu-Zn systems [1-6] as examples of what can be achieved. The most important strategy when matching material to desired plasmon resonance is that the energy range over which interband transitions occur must, in general, be avoided. Given the manner in which the Drude and interband components of the dielectric function interact, the region just below the absorption edge energy is particularly attractive. This can be accessed by suitable selection of material or by manipulation of the geometry or dielectric environment of the nanostructure of interest. In addition to metals, however, a range of semiconducting compounds are also of interest for plasmonic applications, although generally at somewhat longer wavelengths than for the metals. The diverse possibilities offered by these compounds are assessed.

References

1. K. S. B. De Silva, A. Gentle, M. Arnold, V. J. Keast & M. B. Cortie, J. Phys. D: Appl. Phys., vol.48, 2015, pp.215304.
2. V. Keast, K. Birt, C. Koch, S. Supansomboon & M. Cortie, Applied Physics Letters, vol.99, 2011, pp.111908.
3. V. J. Keast, R. L. Barnett & M. B. Cortie, J. Phys. Cond. Matter., vol.26, 2014, pp.article 305501.
4. V. J. Keast, J. Ewald, K. S. B. D. Silva, M. B. Cortie, B. Monnier, D. Cuskelly & E. H. Kisi, J. Alloys & Compounds, vol.647, 2015, pp.129-135.
5. V. J. Keast, B. Zwan, S. Supansomboon, M. B. Cortie & P. O. Å. Persson, J. Alloys Compd., vol.577, 2013, pp.581-586.
6. D. J. McPherson, S. Supansomboon, B. Zwan, V. J. Keast, D. L. Cortie, A. Gentle, A. Dowd & M. B. Cortie, Thin Sol. Films, vol.551, 2014, pp.200-204.

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