Thematic area: Nanooptics and nanophotonics

Competition between the localized surface plasmon and the grating resonances in the optical response of nanogratings

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We review the properties of specific "collective" natural modes existing on periodic arrays of many identical nanoscale scatterers viewed as periodical open resonators [1-6]. Discussion is focused on finite and infinite arrays of silver wires and strips in the visible range. The considered here grating modes are the "parents" to the associated resonances in the electromagnetic-wave scattering and absorption. Their wavelengths are located very close to the Rayleigh anomalies and thus are determined mainly by the period and the angle of incidence. On the frequency scans of the reflectance or transmittance coefficients, the grating resonances are usually observed as Fano-shape spikes, while in the absorption they always display conventional Lorentz-shape peaks. If a grating is made of sub-wavelength size noble-metal elements, grating modes exist together with better known localized surface-plasmon modes whose wavelengths lay in the optical range. Thanks to high tunability and considerably higher Q-factors, the grating-mode resonances can potentially supplement or even replace the plasmon-mode resonances in the design of nanosensors, nanoantennas, and nanoabsorbers for solar cells.

1. *Natarov D.M., Byelobrov V.O., Sauleau R., et al.* Periodicity-induced effects in the scattering and absorption of light by infinite and finite gratings of circular silver nanowires // Opt. Exp. -2011.-**19**, N 22. -P. 22176-22190.
2. *Shapoval O.V., Nosich A.I.* Finite gratings of many thin silver nanostrips: optical resonances and role of periodicity // AIP Adv. -2013. -**3**. P. 042120/13.
3. *Shapoval O.V., Sauleau R., Nosich A.I.* Modeling of plasmon resonances of multiple flat noble-metal nanostrips with a median-line integral equation technique // IEEE Trans. Nanotechnol. -2013. -**12**, N 3. -P. 442-449.
4. *Zinenko T.L., Marciniak M., Nosich A.I.* Accurate analysis of light scattering and absorption by an infinite flat grating of thin silver nanostrips in free space using the method of analytical regularization // IEEE J. Sel. Topics Quant. Electron. -2013.-**19**, N 3. -P. 9000108/8.
5. *Shapoval O.V., Ctyroky J., Nosich A.I.* Resonance effects in the optical antennas shaped as finite comb-like gratings of noble-metal nanostrips // Proc. SPIE. -2013. -**8781**, P. 87810U/8.
6. *Natarov D.M., Sauleau R., Marciniak M., et al.* Effect of periodicity in the resonant scattering of light by finite sparse configurations of many silver nanowires // Plasmonics, 2013 (DOI 10.1007/s11468-013-9636-5).