Abstract

Frequency-selective scattering of light can be achieved by metallic nanoparticle's localized surface plasmon resonance (LSPR). And this property may find application in transparent projection display: ideally, specially designed metallic nanoparticles dispersed in a transparent matrix only selectively scatter red, green and blue light and transmit the visible light of other colors. In this thesis, general properties of LSPR is first reviewed. Then, selective scattering achieved by spherical core-shell structure of $Ag@TiO_2$ (core@shell) is presented. Since metallic nanoparticle's size is comparable to free electrons' mean free path in bulk metal, size effect of metallic nanoparticle on optical scattering and absorption is investigated. After that, selective scattering properties of silver and gold nanocubes placed on dielectric substrate is studied. Finally, the possibility to achieve ultra-sharp scattering peaks (i.e., strong frequency-selectivity of scattering) by combining metallic nanoparticles with gain materials is discussed. Future work includes finding ways to experimentally realize metallic nanoparticles with ultra-sharp scattering peaks, and lowering its cost.

Publication list

[1] *Y. Ye, T. Chen, J. Zhen, C. Xu, J. Zhang, and H. Li, "Resonant scattering of green light enabled by Ag@TiO2 and its application in a green light projection screen," Nanoscale, vol. 10, pp. 2438-2446, 2018.*

[2] *Y. Ye, T. P. Chen, Z. Liu, and X. Yuan, "Effect of Surface Scattering of Electrons on Ratios of Optical Absorption and Scattering to Extinction of Gold Nanoshell," Nanoscale research letters, vol. 13, pp. 299-299, 2018.*

[3] *Y. Ye, R. Liu, Z. Song, Z. Liu, and T. P. Chen, "Sharp selective scattering of red, green, and blue light achieved via gain material's loss compensation," Optics Express, vol. 27, pp. 9189-9204, 2019/03/18 2019.*

[4] *Y. Ye and T. P. Chen, "Selective Scattering of Blue and Red Light Based on Silver and Gold Nanocubes," ECS Journal of Solid State Science and Technology, vol. 8, pp. R51-R57, January 1, 2019 2019.*