Extraordinary Mode Dispersion and Plasmon Properties in Gold Hexagonal Metasurfaces

A F Valitova[1,2], A R Gazizov[1,2], and M Kh Salakhov[1,2]

[1]*Institute of Physics, Kazan Federal University, 18 Kremlevskaya str., 420008, Kazan, Russia*
[2]*Insitute of Applied Research, Tatarstan Academy of Sciences, 20 Bauman str., 420111, Kazan, Russia*
Contact Email: valaigul94@gmail.com

In this paper, the plasmon properties and mode dispersion in a thin flat layer and wavy Au metasurface are investigated. We have established that additional extraordinary optical modes arise in the metasurface, the dispersion of which can be properly designed. As a result of the simulation, we obtained dispersion relations for the modes of a solitary undulating metasurface (in the absence of a photonic crystal). In our work, we consider only the first (main) Brillouin zone. Near the boundaries of the Brillouin zone, the group velocity of the dispersion curves tends to zero. For comparison, we have constructed dispersion relations for a flat Au metasurface of the same thickness. In the case of a wavy metasurface, the presence of periodicity leads to the appearance of additional modes in the high-frequency region, which are similar to the existing low-frequency modes. As the thickness of the Au metasurface increases, the low-frequency even modes disappear. The results obtained demonstrate the possibility of designing optical mode dispersion by changing the thickness and/or period of the wave-like structure of a given metasurface.