Localized surface plasmon resonance (LSPR) wavelength controlled by sputtering current

°Duthika Perera and Ryushi Fujimura

Center for Optical Research and Education (CORE), Utsunomiya University
7-1-2 Yoto, Utsunomiya 321-8585, Japan
mc236540@s.utsunomiya-u.ac.jp

In order to suppress the surface roughness of the metal film during sputtering, low current and short sputtering time are important conditions. However, there was a need to investigate the changes in the internal structure of metal films deposited by low-current sputtering and whether these changes would have a similar effect on the LSPR. Therefore, we prepared glass substrates with Ag semi-shells with different sputtering currents and investigated the changes in LSPR by comparing the spectral measurement results of each. As a result, it was found that the higher the sputtering current, the more the resonance peak wavelength of the Ag semi - shell attached glass substrate shifted to the shorter wavelength side, and the lower the sputtering current, the more the resonance peak wavelength shifted to the longer wavelength side. In low - current sputtering, the number of free electrons in the film produced (volume density of free electrons) tends to be smaller than the number of free electrons in the film produced by high - current sputtering. Films produced by high - current sputtering have a denser and more uniform structure, which is thought to promote the movement of free electrons. On the other hand, in low - current sputtering, the film structure may be sparse and contain many defects such as porosity, which hinders the movement of free electrons. This is because when the volume density of free electrons is high (when the plasma frequency ω_p is high), resonance occurs in the higher frequency region (high frequency region => shorter wavelength side), and when the volume density of free electrons is low (when the plasma frequency ω_p is low), resonance occurs in the lower frequency region (low frequency region => longer wavelength side). The dielectric constant and plasma frequency change due to the influence of the volume density of free electrons and porosity, and if this is utilized efficiently, it will be possible to control the localized surface plasmon resonance wavelength simply by using a single metal and a single structure.

Short biography:

Duthika Perera was born in 1998 in Sri-lanka. She Came to Japan in 2015. She graduated from Tochigi Prefectural Tochigi Shonan High School in March 2019 and entered Utsunomiya University in April. In 2020, she moved on to the Information Electronics and Optics Course in the Faculty of Engineering. She graduated from Utsunomiya University in March 2023 and entered Graduate School of Regional Development and Creativity, Utsunomiya University in April. She is a member of Fujimura Laboratory in Center for Optical Research and Education (CORE). Her research field is Plasmonics.