Development of plasmonic silver nanostructures fabricated by pulsed laser deposition

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Localized surface plasmon resonance (LSPR) is a phenomenon in which the interaction of light with metallic nanostructures induces a substantial photoelectric field enhancement. LSPR is expected to be used for optical devices such as highly sensitive biosensors [1]. In this study, silver nanostructures (Ag-NSs) were deposited on a magnesium oxide (MgO) substrate by pulsed laser deposition (PLD). Figure 1 shows a schematic diagram of the PLD. MgO substrates (Furuichi Chemical, 10 mm × 10 mm, 001 planes) and a disc-shaped silver target were placed in a vacuumed chamber, (pressure 10^{-5} Pa). The MgO substrate was then outgassed (350°C) and cleaned (800°C) by a silicon carbide heater. After the cleaning, the temperature of the MgO substrate was adjusted to be constant at the deposition temperature (350°C), Argon gas flowed into the chamber to control an atmosphere pressure (10^{0} Pa) inside the chamber. A pulsed laser beam (wavelength: 355 nm, fluence: 0.8 J/cm^{-2}, pulse width: 12-18 ns, repetition rate: 4 Hz) was irradiated to the silver target to generate ablation plumes, which were deposited on the MgO substrate. Finally, Ag-NSs were obtained. Figure 2 shows an optical transmittance spectrum of the prepared Ag-NSs on MgO substrate. The spectrum showed a deep decrease peak at a wavelength of about 580 nm. It is considerable that the peak is attributed to the LSPRs exhibited by the interaction between free electrons in Ag-NSs and the light at a specific wavelength.

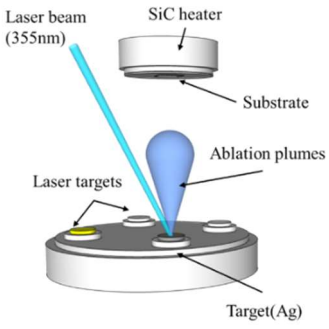

Figure1. Experiment apparatus of PLD

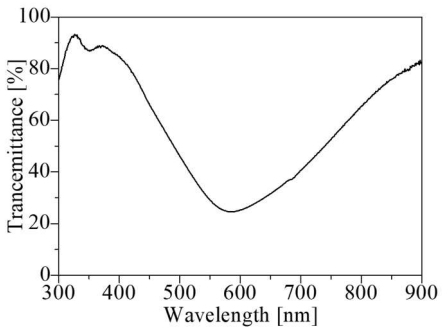

Figure2. The transmittance spectrum of Ag-NSs

References:

[1] S. Kurumi, K. Sugawa, K. Takase, Y. Darma, T. Sagara et al., Appl. Phys. Lett., 123, 053502 (2023).