LASER TREATMENT OF HYBRID TI-AU-AG THIN FILMS AND INVESTIGATION OF THEIR OPTICAL PROPERTIES

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Plasmonic nanostructures are important for sensing and optical spectroscopy because localized surface plasmon resonance (LSPR) strongly controls light absorption and visible color. In this study, plasmon excitation and resonance in a hybrid Ti–Au–Ag thin-film system on soda-lime glass were investigated, focusing on how nanosecond laser processing modifies the optical response. A Ti/Au/Ag trilayer (10 nm per layer) was deposited by magnetron sputtering and subsequently patterned by laser irradiation, following established approaches for laser-induced plasmonic nanoparticle formation. [1] The average laser power (0.1–0.8 W) and lens–substrate distance (12.3–16.92 cm) were varied to generate colored nanoparticle regions. Six squares (K1–K6) showing the largest color differences were selected and analyzed using UV–Vis reflectance and transmittance spectroscopy, and extinction spectra were derived. All laser-processed regions exhibit a single dominant extinction band in the visible range, with peak positions spanning approximately 480–490 nm to 608 nm, consistent with the observed structural colors. Strongly red-shifted and broadened resonances indicate increased coupling and/or larger effective features, while shorter-wavelength peaks suggest a more Ag-like response. Overall, the results demonstrate that laser processing enables effective tuning of LSPR and color in Ti–Au–Ag layers, where both Au/Ag contribution and the titanium (or TiOx) environment influence the resonance position and bandwidth.

[1] V. Petrikaitė, I. Ignatjev, A. Selskis, G. Niaura, and E. Stankevičius, “Hybrid gold-silver nanoparticles synthesis on a glass substrate using a nanosecond laser-induced dewetting of thin bimetallic films and their application in SERS,” Opt. Laser Technol., vol. 168, Art. no. 109956, Jan. 2024, doi: 10.1016/j.optlastec.2023.109956.