

Nanomaterials with Tunable Optical Properties for Advanced Functional Applications

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Nanomaterials with tunable optical properties constitute one of the most rapidly developing groups of advanced functional materials due to their unique physicochemical characteristics and wide application potential. In particular, plasmonic nanostructures based on noble metals have gained considerable attention because of their ability to interact with electromagnetic radiation, leading to phenomena such as localized surface plasmon resonance (LSPR), enhanced light absorption, and improved optical sensitivity. These properties make them promising candidates for numerous applications in modern materials science, nanotechnology, biomedicine, sensing, imaging, catalysis, and theranostic systems [1]. Among various nanostructured systems, core-shell architectures offer exceptional opportunities to precisely modulate optical responses through controlled engineering of both the metallic core and the surrounding shell. Silica-coated plasmonic nanoparticles, including Au@SiO₂ and Ag@SiO₂, are particularly attractive due to their improved colloidal stability, enhanced biocompatibility, protection of the metallic core against aggregation or oxidation, and facile surface functionalization. Furthermore, the silica shell enables fine-tuning of interfacial interactions and optical behavior while maintaining the plasmonic properties of the metallic nanoparticles [2].

The current research focuses on the synthesis and comprehensive characterization of plasmonic core-shell nanomaterials based on silica-coated gold and silver nanoparticles. Structural and optical characterization was conducted using spectroscopic and microscopic techniques. The obtained results demonstrate that the designed Au@SiO₂ and Ag@SiO₂ core-shell nanostructures enable effective modulation of their optical properties and confirm their potential as multifunctional nanoplatforms for advanced technological and biomedical applications.

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2. Pustovalov, V.K.; Astafyeva, L.G.; Fritzsche, W. Optical Properties of Core-Shell Nanoparticles and Their Application for Effective Absorption, Scattering, Extinction and Filtering Solar and Optical Radiation. *Photonics and Nanostructures - Fundamentals and Applications* 2024, 62, 101312, doi:10.1016/j.photonics.2024.101312.

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