Chemical Fabrication of Gold Nanorings: Controlled Reduction and Optical Tuning for Nanomedicine Applications

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Abstract: This research investigates the production of nanoring structures through a chemical reduction approach, exploring gradual reduction processes assisted by reductant agents, leading to the formation of these specialized nanorings. The study focuses on the controlled reduction of metal atoms within these agents, crucial for shaping these nanoring structures over time. The paper commences by highlighting the wide-ranging applications of metal nanostructures across fields like Nanomedicine, Nanobiotechnology, and advanced spectroscopy methods such as Surface Enhanced Raman Spectroscopy (SERS) and Surface Enhanced Infrared Absorption Spectroscopy (SEIRA). Particularly, gold nanoparticles, especially in the nanoring configuration, have gained significant attention due to their distinctive properties, offering accessible spaces suitable for sensing and spectroscopic applications. The methodology involves utilizing human serum albumin as a reducing agent to create gold nanoparticles through a chemical reduction process. This process involves the transfer of electrons from albumin's carboxylic groups, converting them into carbonyl, while AuCl4- acquires electrons to form gold nanoparticles. Various characterization techniques like Ultraviolet-visible spectroscopy (UV-Vis), Atomic-force microscopy (AFM), and Transmission electron microscopy (TEM) were employed to examine and validate the creation and properties of the gold nanoparticles and nanorings. The findings suggest that precise and gradual reduction processes, in conjunction with optimal pH conditions, play a pivotal role in generating nanoring structures. Experiments manipulating optical properties revealed distinct responses in the visible and infrared spectrums, demonstrating the tunability of these nanorings. Detailed examinations of the morphology confirmed the formation of gold nanorings, elucidating their size, distribution, and structural characteristics. These nanorings, characterized by an empty volume enclosed by uniform walls, exhibit promising potential in the realms of Nanomedicine and Nanobiotechnology. In summary, this study presents a chemical synthesis approach using organic reducing agents to produce gold nanorings. The results underscore the significance of controlled and gradual reduction processes in crafting nanoring structures with unique optical traits, offering considerable value across diverse nanotechnological applications.

Keywords : nanoring structures, chemical reduction approach, gold nanoparticles, spectroscopy methods, nano medicine applications

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