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Synthesis of Size and Surface Dependent Gold Nanoparticles for Future Bioaccumulation Studies

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Nanoparticles (NPs) have become a hot topic in the development of new, highly sensitive diagnostic methods, especially regarding targeted applications. Shape and size are defined by the properties of the inorganic core and the polymer-shell is of utmost importance for the functionality. This study aims the synthesis and surface functionalisation of Gold Nanoparticles (AuNPs) and Nanoclusters with controlled sizes. Objective is the establishment of a library of suitable candidates for future investigations of bioaccumulation and biodistribution. Citrate capped AuNPs with core diameters of 5, 13, 18 and 25 nm were synthesized following established protocols.1 To enhance stability and biocompatibility, particles were coated with poly(isobutylene-alt-maleic anhydride) (PMA) via PEGylation (PEG@AuNPs) followed by Dodecylamine (DDA) modification.1 This approach yielded non-toxic, stable PMA coated AuNPs with different core sizes. To explore size-dependent effects also on smaller particles below 2 nm, N-acetyl-L-cysteine (ACC) and 6-aza-2-thiothymine (ATT) stabilized nanoclusters (1.6 nm and 1.4 nm respectively) were synthesized.2 However, ATT-stabilized clusters showed poor stability under physiologically relevant ionic conditions and were therefore excluded from the final library. The resulting collection of stable, surface-engineered AuNPs and nanoclusters provides a platform for evaluation of size- and surface-dependent biodistribution and bioaccumulation, with potential implications for nanoparticle-mediated diagnostics and therapeutic applications.

1 Selected Standard Protocols for the Synthesis, Phase Transfer, and Characterization of Inorganic Colloidal Nanoparticles; J. Hühn, et al.; Chemistry of Materials 2017 29 (1), 399-461; DOI: 10.1021/acs.chemmater.6b04738
2 Size- and Ligand-Dependent Transport of Nanoparticles in Matricaria chamomilla as Demonstrated by Mass Spectroscopy and X-ray Fluorescence Imaging; Y. Liu, et al.; ACS Nano 2022 16 (8), 12941-12951; DOI: 10.1021/acsnano.2c05339

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