Gold Nanoparticles: Efficient Synthesis of Catalytically Active Nanoparticles Using a One-Pot Method

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Gold nanoparticles have recently come to prominence due to increased demand for nanoscale technologies. Nanoparticles of different shapes have unique capabilities. Current methods for synthesizing variably shaped gold nanoparticles require time intensive, multi-step procedures. In this study, a single-step, one-pot approach to non-spherical gold nanoparticle synthesis is developed using poly(glycidyl methacrylate) (PGMA) microspheres as the novel reductant in the synthesis process. PGMA's reactive functional groups and slow reducing capabilities made it a promising method for single step nanoparticle synthesis. Two reaction parameters (chloroauric acid concentration and reaction temperature) were optimized for the PGMA induced gold nanoparticle synthesis (1mM, 90°C-110°C). Transmission electron microscopy and UV-VIS spectroscopy conducted on timed extractions of the PGMA/gold nanoparticle solutions showed evidence of morphological evolution (aggregations → mixture of non-spherical shapes → spheres) and increased particle size over time. Catalysis tests on the nanoparticles found that aggregates and spherical particles had the strongest catalytic properties. These results demonstrate the effectiveness of PGMA as a reductant in the one-pot synthesis of catalytically active gold nanoparticles. Furthermore, this process represents a 60%-90% reduction in synthesis time compared to conventional multi-step procedures for non-spherical gold nanoparticle production. The effectiveness of PGMA in this study, along with the speed of the one-pot process enables more efficient synthesis of gold nanoparticles, with the potential to help facilitate their production and implementation in emerging industrial and medical applications such as drug delivery, biodetection, and catalysis.

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