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Shape Control of Gold Nanocrystal: Synthesis of Faceted Gold Nanoparticles and Construction of Morphology Diagram

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Shape control of gold nanocrystal is still one of the most important challenges remaining to achieve geometry dependent properties. Thus far, several strategies have been developed to control the shape of nanoparticles, such as adding capping agents and diverse additives or adjusting the temperature and pH. Here, we used an already established seed-mediated method that allowed us to focus on controlling the growth stage. Cetyltrimethylammonium bromide (CTAB) and ascorbic acid (AA) were used as the ligand and the reducing agent, respectively, without using any additional additives during the growth stage. We investigated how the relative ratio of CTAB and AA concentrations could be a major determinant of nanoparticle shape over a wide concentration range of CTAB and AA. As a result, a morphology diagram was constructed experimentally that covered the growth conditions of rods, cuboctahedra, cubes, and rhombic dodecahedra. The trends in the morphology diagram emphasize the importance of the interplay between CTAB and AA. Furthermore, high-index faceted gold nanocrystal was obtained by two step seeded growth. Already synthesized cubic particles developed into hexoctahedral nanocrystal consisting of 48 identical {321} facets, which indicates that the growth of gold nanocrystal is affected by initial morphology of seed particles. The hexoctahedral gold nanoparticles can be used in catalysis and optical applications which exploiting their unique geometry. Our research can provide useful guidelines for designing various facetted geometries.

Keywords: gold, nanoparticle, morphology, shape control

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Photoluminescent Graphene Oxide Microarray for Multiplex Heavy Metal Ion Analysis

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Since heavy metal ions included in water or food resources have critical effects on human health, highly sensitive, rapid and selective analysis for heavy metal detection has been extensively explored by means of electrochemical, optical and colorimetric methods. For example, quantum dots (QDs), such as semiconductor QDs, have received enormous attention due to extraordinary optical properties including high fluorescence intensity and its narrow emission peaks, and have been utilized for heavy metal ion detection. However, the semiconductor QDs have a drawback of serious toxicity derived from cadmium, lead and other lethal elements, thereby limiting its application in the environmental screening system. On the other hand, Graphene oxide (GO) has proven its superlative properties of biocompatibility, unique photoluminescence (PL), good quenching efficiency and facile surface modification. Recently, the size of GO was controlled to a few nanometers, enhancing its optical properties to be applied for biological or chemical sensors. Interestingly, the presence of various oxygenous functional groups of GO contributes to opening the band gap of graphene, resulting in a unique PL emission pattern, and the control of the sp2 domain in the sp3 matrix of GO can tune the PL intensity as well as the PL emission wavelength. Herein, we reported a photoluminescent GO array on which heavy metal ion-specific DNA aptamers were immobilized, and sensitive and multiplex heavy metal ion detection was performed utilizing fluorescence resonance energy transfer (FRET) between the photoluminescent monolayered GO and the captured metal ion.

Keywords: Biosensors, Graphene, Arrays, Silver, Mercury, FRET