Project ID: 191

SR - Chemistry

Rishika Kulkarni

Novel PSS-Driven Ligand Exchange on the Surface of Gold Nanocubes

Recent years have seen a dramatic increase in the applications of gold nanoparticles, due to their low toxicity, high stability, and their unique optical properties, heavily influenced by particulate shape and size. Gold nanocubes (AuNC), with sharp edges and flat surfaces, are of interest due to their tunable electromagnetic properties, high electron density, and photoluminescence quantum yield. However, the production of such nanoparticles requires a complex multistep synthesis, including surface stabilizing agents such as CTAC and CTAB (cetyltrimethylammonium chloride; -bromide). Due to their cytotoxicity, formation of a robust double layer, and frequent destabilization during surfactant exchange, CTAC must be removed from the AuNCs surface for further modifications but this leads to partial aggregation and low recovery yields. In this study, the use of a PSS-driven ligand exchange is investigated to overcome these issues by experimenting with three different combinations of PSS and CTAC. Polystyrenesulfonate (PSS) was used as an intermediate detergent to remove CTAC and stabilize the AuNCs in citrate. It is shown that these citrate-stabilized AuNCs are stable at low ionic strengths and are amenable to further modifications. It was proven that more than one PSS wash is needed to completely remove CTAC and that one citrate wash was not sufficient to remove more than one wash of PSS. This new approach forms the basis for future research in surfactant exchange on AuNCs and is applicable to biosensing abilities within the human body. Further studies regarding the citrate-capped nanocube include analyzing the surface chemistry and testing stability.

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SR - Chemistry

Nathan Xiong

Effective Separation of Fatty Acids Using COF Incorporated Epoxy Membranes

Fatty acids (FAs) are easily isolated from vegetable oil and are important starting materials for the chemical industry to produce commercial products that are green, biorenewable, and nontoxic. A challenge in these applications is that mixtures of five or more FAs are isolated from a vegetable oil source and methods to separate these mixtures are decades old and have increasingly high costs associated with the production of high purity single component FAs. We developed a method to separate these mixtures using mixed matrix membranes containing nanometer-sized covalent organic frameworks. We hypothesized that the 2D, crystalline COFs which possess narrow distributions of pore sizes will separate FAs based on their degrees of saturation. The COFs were synthesized, characterized, and then encapsulated at 20% by weight into a prepolymer of epoxy that was then fully cured. For all membranes, as the degree of unsaturation increased the FAs had slower flux. The largest difference in flux was obtained for a COF/epoxy membrane with pore sizes of 1.8 nm: stearic acid had a 4.5x faster flux than linolenic acid, displaying that our hypothesis is supported. These are the first membranes that can separate the important C18 FAs found in vegetable oil.