Selective detection of nanomaterials: Gold nanorod imprinted matrices

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Anisotropic nanostructures such as nanorods can be found in an increasing number of applications such as catalysis and imaging. Although their synthesis is well developed, their selective detection and separation are still in their infancy. Here, we demonstrate for the first time the selective recognition of gold nanorods (GNRs) by the nanoparticle-imprinted matrix (NAIM) approach. Specifically, GNRs stabilized by citrate (GNRs-cit) were adsorbed on an electrode surface modified with a positively charged polymer. The adsorption was followed by the electrochemical deposition of an aryldiazonium-based matrix around the GNRs-cit. Nanocavities having the shape of the imprinted GNRs were formed upon the removal of the nanoobject by electrochemical dissolution. We find that these nanocavities showed the ability to reuptake selectively GNRs similar to those initially imprinted. Furthermore, our findings clearly show that the recognition of the GNRs, namely, their reuptake by the nanocavities, depends on both the physical, i.e., structural fitness, and the chemical interactions between the imprinted GNRs and the matrix. For example, whereas a matrix bearing carboxylic acid functionalities repelled the GNRs stabilized by citric acid, a matrix formed by the electropolymerization of 4-acetylbenzenediazonium (ABD) exhibited good reuptake. A reuptake percentage, which is the ratio between the number of GNRs uptaken by the nanocavities divided by the number of the originally imprinted GNRs, of ca. 50% was obtained.