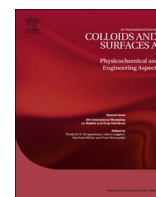




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One-step synthesis of gold colloids using amidoaminocalix[4]resorcinarenes as reducing and stabilizing agents. Investigation of naproxen binding



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ABSTRACT

Amido(dimethylamino) calix[4]resorcinarenes with different substituents on the lower rim ($-\text{CH}_3$ (C1), $-\text{C}_5\text{H}_{11}$ (C5), $-\text{C}_{11}\text{H}_{23}$ (C11)) both as reducing and stabilizing agent in an aqueous solution were used for the fabrication of stable gold colloids. Gold colloids are characterized by spectrophotometry, FTIR – spectroscopy, transmission electron microscopy, dynamic light scattering. It is found that increase of the macrocycle's concentration towards HAuCl_4 concentration during the synthesis leads to the decrease in the size of formed particles. It is shown that the size of gold nanoparticles (AuNPs) decreases with the increase of the hydrophobicity of the substituents on the macrocycles lower rim (C1@Au – 4–14 nm, C5@Au – 10–11 nm, C11@Au – 7–8 nm). The monolayer packing of the macrocycle molecules on the surface of the metal particle for C1@Au and bilayer – for C5@Au and C11@Au, providing both the stabilization of AuNPs and their solubility in water, are proposed. Temperature and pH variation during the synthesis showed that the optimal synthesis conditions for all kinds of particles C1@Au, C5@Au, C11@Au are spontaneous installed during the synthesis pH (for C1@Au – pH 8.10, C5@Au – pH 8.56, C11@Au – pH 8.63) and the synthesis temperature of the 25 °C.

High binding fraction of drug substrate naproxen on the surface of AuNPs modified by C5 and C11 macrocyclic aggregates due to the ordering of the macrocycles on the particle surface and enhancing their receptor ability towards naproxen is defined by fluorescence method.

1. Introduction

Currently, a promising way in the field of nanotechnology is the development of methods and approaches to the synthesis of nanoparticles (NPs) and nanostructures, possessing new useful properties. Studies of gold NPs are especially intensive developed because their properties have great differences in the nanometer range and in the bulk metal samples [1,2]. Due to a number of features which are caused by the size and internal structure of NPs, they possess a unique combination of electronic, magnetic, optical, and other properties that are not specific to the “bulk” metals [3,4].

Thus, the properties of gold nanoparticles (AuNPs) are directly dependent on their size and shape. The surface plasmon resonance (SPR) in the gold metal provides the optical properties of colloidal AuNPs [5]. Namely this phenomenon led to the idea of using gold clusters as markers for biological objects studying. And the possibility

to control their size is one of the key problems in the creation of nanoscale materials.

AuNPs have a good biocompatibility. There are a lot of works which are devoted to the binding of AuNPs by biological molecules – peptides, proteins and nucleic acids [6,7]. The strong resonance absorption and scattering of light by AuNPs allows studying their behavior both «in vitro» and «in vivo», opening the possibility of their application in the field of therapeutic diagnosis, biomarkering and targeted drug delivery [8,9].

It is known that colloidal gold particles tend to aggregate due to the nature of the transition metal. The aggregation of the particles goes with the loss of their unique physical and chemical properties. It is possible to avoid the collapse of AuNPs and to obtain stable ones, if synthesize them in the presence of organic agents, “wrapping” or “functionalizing” NPs by ionic, coordination or hydrophobic interactions with their surface. Thiols, disulfides, citrates, ethers, amines,

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