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Photocatalytic properties of supramolecular nanoassociates based on gold and platinum nanoparticles, capped by amphiphilic calix[4]resorcinarenes, towards organic dyes

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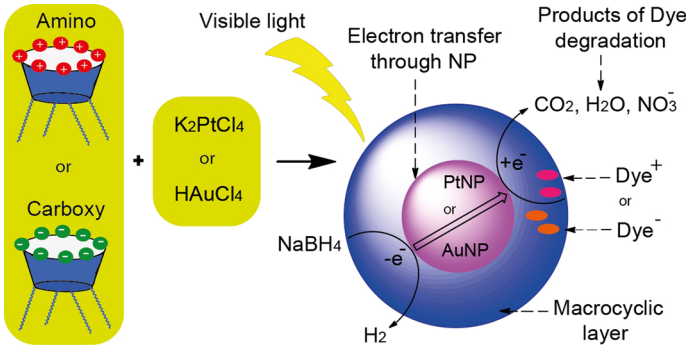
GRAPHICAL ABSTRACT



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ABSTRACT

The synthesis of colloidal platinum nanoparticles (PtNPs) ($d_{core} \approx 1\text{-}40\ nm$) in an aqueous solution was carried out using amido(dimethyl)amino- and carboxy- calix[4]resorcinarenes with alkyl substituents on the lower rim as stabilizer. The nanoparticles were characterized by spectrophotometry, IR, TEM, DLS, PXRD and SAXS. It was shown that PtNPs and gold nanoparticles (AuNPs) obtained, stabilized by calix[4]resorcinarenes, demonstrate the photocatalytic activity in the photodegradation of methyl orange and rhodamine B toxic dyes under visible light irradiation. The rate constants of catalytic reaction (K_1, min^{-1}) and activity of nanocatalysts (K_2, $min^{-1}\,mol^{-1}$) were calculated. It was found that size of metal core, structure of macrocycle stabilizing the surface of metal nanoparticles, its ability to form self-associates and bind dye molecules define the rate of dye photodegradation reaction. The study of the interaction of PtNPs and AuNPs capped with amidoamine macrocycles with organic photolinkers by spectrophotometry and fluorescence showed the binding of photolinkers by macrocycles, PtNPs and AuNPs. The photocatalytic activity of obtained cooperative nanoassociates was studied. The addition of photolinkers leads to both an increase and a decrease in the reaction rate, depending on the structure of linker and macrocycle. An increase in the reaction rate occurs due to the formation of photoactive supramolecular nanoassociates and the additional photosensitizing action of the photolinker on the surface of a

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