Absorption Spectra and Kinetics of J-aggregation of Thiacyanine Dye in Aqueous Solution

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Absorption spectra of composite silver nanoparticles/thiacianine dye in aqueous solution and kinetics of the J-aggregate formation are investigated. The J-aggregation of thiacyanine dye (TC, 5,5-disulfopropyl-3,3-dichlorothiacyanine, structure is shown in Figure.1) on surface of silver nanoparticles[1] are specifically studied. The obtained Ag colloidal dispersions were characterized by UV-Vis spectrophotometry. Formation of TC dye J-aggregates on the surface of nanoparticles was monitored by the change of absorption spectra which exhibits appearance of the new absorption band at 481 nm. Kinetic measurements were carried out using a stopped-flow method, monitoring change of absorbance at 481nm. The rate of J-aggregate formation increases with increasing concentrations of TC dye and kinetic curves are sigmoidal-type. The kinetics are described in framework of autocatalysis and the relevant parameters are determined by fitting procedures. Dye working solutions was in range 1.67 x 10^{-6} M – 1.67 x 10^{-5} M, while concentration of Ag colloidal was constant 7.55 x 10^{-8} M. The rate constant increases (0.92 s^{-1} – 4.79 s^{-1}) with increasing dye concentration. Further mechanistic insight into the nature of electrostatic forces responsible for J-aggregate formation are discussed.

Figure 1. Structure of thiacyanine dye.

KEYWORDS: silver nanoparticles, thiacyanine dye, absorption spectra, kinetics

REFERENCES: