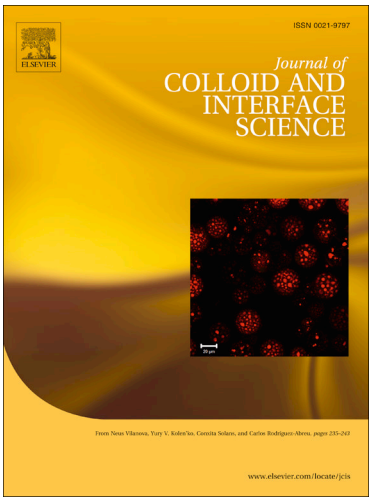

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Bonding of doxorubicin to nanosilica and human serum albumin in various media

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Abstract

Interaction of doxorubicin hydrochloride (DOX) (anti-cancer drug) with hydro-compacted nanosilica A-300 (cA-300) alone or cA-300/human serum albumin (HSA) at a small content of water (h = 0.4 g per gram of dry silica) in different dispersion media (air, chloroform, and chloroform/trifluoroacetic acid) was analyzed using low-temperature ^{1}H NMR spectroscopy, NMR cryoporometry and quantum chemistry to elucidate specific changes in the interfacial layers. Initial (bulk density $\rho_b \approx 0.046$ g/cm^3) and hydro-compacted ($\rho_b \approx 0.051$-0.265 g/cm^3 as a function of the hydration degree) nanosilicas were analyzed using nitrogen adsorption-desorption, gelatin adsorption, small angle X-ray scattering (SAXS), TEM, and infrared (FTIR) spectroscopy. Equilibrium adsorption of DOX onto cA-300 and cA-300/HSA was analyzed using ultraviolet-visible light spectroscopy. Photon correlation spectroscopy was used to analyze the particle size distribution in aqueous suspensions with various contents of components. DOX more strongly bound to HSA than silica also affects structure of interfacial water layers that depends on dispersion media because chloroform as immiscible with water changes the water organization to enlarge water structures. In aqueous media, DOX alone remains mainly in the form of nano/microparticles (50 nm – 2 μm in size). However, with the presence of cA-300, cA-300/HSA, and HSA alone DOX transforms into pure nano-sized structures. These effects are explained by effective bonding of DOX to HSA having good transport properties with respect to drug molecules/ions that exceed similar properties of nanosilica alone, but cA-300/HSA can be a more effective composite as a drug carrier.

Keywords: Doxorubicin hydrochloride; Nanosilica; Human serum albumin; ^{1}H NMR spectra; Bound water organization; Freezing-melting point depression; Drug delivery system

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