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Synthesis of Core-Shell Particle Colloidal Solutions for Imaging Processes

Authors : Yoshio Kobayashi, Kohsuke Gonda

Abstract : In medical diagnostics, contrast agents are used to improve the performance of X-ray, magnetic resonance, and fluorescence-based imaging. A variety of contrast agents are commercially available. Typical commercial contrast agents include solutions containing iodine compounds for X-ray imaging and gadolinium complexes for magnetic resonance imaging. Metal-gold nanoparticles can also exhibit X-ray imaging capabilities. Because of their small size, these contrast agents are not strongly attracted to liquids. Therefore, they cannot remain in vivo for long periods of time, making it difficult to obtain stable images. Forming contrast agent particles and increasing their apparent particle size is expected to be a solution to this problem, as they have a larger projected area than molecules or nanoparticles and thus have a longer residence time. In addition, contrast agents can cause adverse reactions derived from iodine, metallic gold, gadolinium ions, and cadmium. Coating particles with a shell that is inert to living organisms is a candidate for suppressing side reactions because the particles cannot contact the organism. Our laboratory has recently developed a method for the preparation of colloidal solutions of core-shell particles with an imaging-competent material as the core and biologically inert silica as the shell and studied their imaging properties. The method used was based on the hydrolysis and condensation of silicon alkoxide in the presence of particles such as iodine compound nanoparticles prepared by mixing aqueous AgClO4 and KI solutions, metal Au nanoparticles prepared by reducing HAuCl4 with citric acid, gadolinium compound nanoparticles prepared by the homogeneous precipitation method, and commercial cadmium compound nanoparticles so that silica nuclei generated from silicone alkoxide deposited on the particles to form silica shells. The prepared particle colloidal solutions showed notable imaging capabilities. For example, a computed tomography value of the silica-coated Au nanoparticle colloidal solution was higher than that of a commercial X-ray contrast agent for the same Au or iodine concentrations. In this contribution, we present our studies on the imaging capability of particle colloidal solutions that we have been conducting for the past few years.

Keywords : core-shell, particles, colloid, imaging
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