

Gd₂O₃@SiO₂ nanoparticles with core-shell structure for magnetic resonance imaging and computed tomography

Tuesday 29 October 2024 13:15 (15 minutes)

The continued development of multimodal medical imaging creates demand for contrast agents (CAs) that can be used with multiple imaging techniques. An example of such CAs are Gd-based materials that can be used in magnetic resonance imaging (MRI) and computed tomography (CT), including photon-counting CT. A type of Gd-based material of special interest is nanoparticles with a core-shell structure consisting of a Gd-containing core and a shell formed by amorphous SiO₂ with a surface modified with functional groups [1].

The purpose of this work was to produce particles with a core-shell structure Gd₂O₃@SiO₂ and prove their structure for subsequent use as contrast agents for computed tomography and MRI.

Gd₂O₃ nanoparticles were produced by precipitation of Gd₂(C₂O₄)₃·10H₂O with subsequent decomposition at 750 °C in an air atmosphere. The particle size, according to scanning electron microscopy (SEM), was 200-500 nm. The particle size in an aqueous suspension, measured by the method of optical scattering of particles suspended in water, was 5-10 μm, which probably corresponds to the size of the associates. Particles with a core-shell structure were produced by treating Gd₂O₃ with (EtO)₃SiC₃H₆NH₂ (γ-APTES) and then with H₂O vapors in a fluidized bed reactor. In this case, the treatment time with γ-APTES was varied from 5 to 30 min, and the temperature of the reactor working zone was varied from 150 to 250 °C [2].

According to IR spectroscopy data, all produced preparations contained a characteristic peak of [SiO₄] at 1100 cm⁻¹. According to TG data, the weight loss at 250-600 °C was from 0.8 to 1.2 wt. %, that corresponds to different contents of functional C₃H₆NH₂ groups.

This research was supported by Russian Science Foundation (project number 22-15-00072).

Literature:

1. Evgeniya Suslova, Denis Shashurin, Zukhro Zoirova, Alexey Shumyantsev, Oleg Medvedev, Georgy Chelkov.

Gd₂O₃-based contrasting agents for photon-counting computed tomography: Effect of structure, composition, and particle size. *Materials Chemistry and Physics*, Volume 313, 2024, 128733, ISSN 0254-0584. <https://doi.org/10.1016/j.matchemphys.2024.128733>

2. Amirhossein Mahtabani, Damiano La Zara, Rafał Anyszka, Xiaozhen He, Mika Paajanen, J. Ruud van Ommen, Wilma Dierkes, Anke Blume. Gas Phase Modification of Silica Nanoparticles in a Fluidized Bed: Tailored Deposition of Aminopropylsiloxane. *Langmuir* 2021, 37, 15, 4481–4492. <https://pubs.acs.org/doi/10.1021/acs.langmuir.0c03647>.

Primary authors: KUPRIANOV, Anton (Chemistry department, Lomonosov Moscow State University); Dr SHASHURIN, Denis (Faculty of Medicine, Lomonosov Moscow State University); Dr SUSLOVA, Evgeniya (Chemistry Department, Lomonosov Moscow State University); Dr SHELKOV, Georgiy (Joint Institute for Nuclear Research)

Presenter: KUPRIANOV, Anton (Chemistry department, Lomonosov Moscow State University)

Session Classification: Applied Research

Track Classification: Applied Research