

Development of X-ray CT contrast agents based on tantalum oxide nanoparticles and their applications

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Computed tomography (CT) is based on x-ray attenuation of elements. To overcome the limitation of iodinated molecules, nanoparticles based on heavy atoms such as gold, lanthanides, and tantalum have been studied as more efficient CT contrast agents. Uniformly sized tantalum oxide nanoparticles were prepared using a microemulsion method, and their surfaces were modified using various silane derivatives. The silane-modified surface enabled facile immobilization of functional moieties such as polyethylene glycol (PEG) and fluorescent dyes. PEG was introduced to endow the nanoparticles with biocompatibility and antifouling activity, and immobilized fluorescent dye molecules enabled simultaneous fluorescence imaging as well as X-ray CT imaging. The resulting nanoparticles exhibited remarkable performances in the in vivo X-ray CT angiography and bimodal image-guided lymph node mapping. We also performed an extensive study on in vivo toxicity of tantalum oxide nanoparticles, revealing that the nanoparticles did not affect normal functioning of organs.