Since size and shape are crucial to physical and chemical properties of nanoparticles, size and shape control of nanoparticles becomes an appealing research area. Nanomaterials with tailored size and shape found their application in many research fields, such as catalysis, drug delivery, biosensors, MRI contrast agents, data storage, magnetorefrigeration, and nanomedicines. Alkalide reduction is a solution-based method for synthesizing nanomaterials as small as < 1 nm diameter and as large as many 10’s of nm. This method is capable of preparing a variety of nanomaterials, including metal, intermetallic alloys, and core-shell nanomaterials. Its use of alkali metal anions and/or solvated electrons make it capable of reducing cations across the periodic table to form nanomaterials of even the early transition metals and is the only solution method known capable of producing lanthanide nanoparticles.

Recently, air, moisture and acid stable gold-coated gadolinium (Gd@Au) nanoparticles were prepared by alkalide reduction. The synthesis resulted in core-shell nanocrystals with a narrow size distribution. The Gd core could make the nanocrystals excellent molecular MRI contrast agents and provide a number of options for treatment of tumors, including 157Gd neutron capture therapy, photon activation therapy, synchrotron stereotactic radiotherapy, and 159Gd radionuclide therapy. The Au shell prevents Gd core from oxidation renders them stable even at low pH, which potentially prevents leaching and bio-incompatibility. T1 and T2 relaxivities indicate that Gd@Au nanocrystals are a very promising potential T1 MRI contrast agent.

Tuning the size of the Gd@Au nanocrystals could make them more effective MRI contrast agents and allow for additional applications. Reducing the thickness of the Au coating and the size of the core could decrease the average closest approach distance for water and thus increase relaxivity. The magnetic properties of the Gd cores could be tuned by increasing their size, allowing them to be used as magnetic refrigerants and hyperthermia agents. However, there has been very little research into the control of the size of the nanocrystals that are the product of alkalide reduction. The results of a systematic investigation of the alkalide reduction synthesis of Au nanocrystals with fine size control and very narrow size distributions will be presented.

BIO

Ming Zhang received his Bachelor’s and Master’s Degree (B.Sc, M.Sc) in Chemistry from Nankai University, P.R. China. Before his Ph.D. studies, he worked on molecular magnets based on cyano-bridged hexacyanochromate(III) complexes in their nanoscales. He will earn his Ph.D. in Physical Chemistry from George Washington University. His current research includes fine size control of gold nanoparticles, relaxation of gold-coated gadolinium and europium as MRI contrast agents, and gold-coated gadolinium cobalt alloys.

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