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## Microstructures of metal nanoparticles

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Nanoparticles have recently attracted great interest due to their novel electronic, optical, magnetic and chemical properties. Contrast to the intensive investigation for crystalline nanoparticles, less attention has been devoted to amorphous nanoparticles, partly due to the difficulties in structure characterization for disordered systems. With a newly developed parameter-free method, the structure evolutions during rapid cooling processes and in the final frozen nanoparticles have been investigated for nano-droplets each containing 10,000 silver atoms. The molecular dynamic simulations are conducted at different cooling rates from $1.0\times10^{11}$ K/s to $1.0\times10^{15}$ K/s. Take the specific short-range order of icosahedron as the indicator, the resulting nanoparticles can be divided into three categories: 1) single crystal, in which no icosahedron exists 2) multiple-twined particle, in which few icosahedrons may be appear where 12 5-fold twin boundaries meet together, and 3) amorphous nanoparticle (ANP), in which up to 12% atoms (ico-atoms) are involved in icosahedrons. Depth structure analysis for ANPs reveals that they can be further classified into three groups: 1) liquid-like ANP, which can be obtained as the cooling rate is so high that the ico-atoms are increasing (<12%) during the whole cooling process 2) ico-saturated ANP, in which the ico-atoms maintain the maximum (~12%), and 3) local crystalized ANP, in which local ordered structures composed of fcc and hcp clusters (including 13 atoms) distribute randomly. The major crystalline clusters such as fcc and hcp, are also investigated, as well as the truncated decahedrons which comprise the stem of 5-fold twin boundaries.

### Biography

Zean A. Tian has completed his Ph.D. in 2009 from Hunan University, P. R. China and is taking his postdoctoral studies at the University of New South Wales (UNSW), Australia. He focuses on the study on structural analysis of disordered systems and molecular dynamic simulation of rapid cooling for metals. He has published more than 30 papers in reputed journals and has been awarded the Vice Chancellors Postdoctoral fellowship in 2011 at UNSW, Australia.

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## Magnetic field processing of weakly magnetic materials: Fundamentals and applications

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Static magnetic field processing of materials, especially of weakly magnetic, has been of broad interest and been applied in such fields as drug delivery, colloid chemistry and engineering of materials containing particles. A magnetic field needs to reach a critical value that can generate significantly 'strong' response from the manipulated material and can vary for different materials. The response is corresponding to a local interaction between the material and the local magnetic field, being influenced by the magnetic susceptibilities of the material and the surrounding/coated medium. By carefully designing the medium, a significantly 'strong' response from a weakly magnetic material can even be generated by a traditional magnet, i.e. magnetic flux density ~0.01 Tesla. Therefore, the ability to manipulate materials by using a magnetic field depends critically on the understanding of the fundamentals of the magnetic properties of materials and their magnetic responses. This work provides a critical discussion on the fundamentals including magnetic field effect thermodynamics, magnetic energy, magnetic anisotropy and different magnetic forces, and applications including solidification, colloid chemistry, during 'strong' magnetic field processing of weakly magnetic materials. A series of case studies and the related magnetic field effect have been integrated and discussed. Overall this work aims to provide a better understanding and control of the process of static magnetic field manipulations.

### Biography

Z. H. I. Sun has completed his Ph.D. from KU Leuven, Belgium. After postdoctoral research in KU Leuven, he joined The University of Queensland at 2012. He has published more than 30 papers in reputed journals and serving as an editorial board member of Journal of Powder Metallurgy and Mining.

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