

Nanostructured Hard Magnetic Materials ----- the Present and Future

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Abstract:

For energy-related applications and green technologies, stronger permanent magnets are increasingly demanded, especially the rare-earth hard magnetic materials. Exchange-coupled nanocomposite magnets are regarded as the next generation of permanent magnets, based on the raw materials availability and the high performance predicted by the theoretical simulations. However, many challenges remain in fundamental understanding and experimental production of nanostructured composite magnets. We have started the bottom-up approaches to synthesis of the hard and soft magnetic nanoparticles and the bulk nanocomposite magnets. Novel techniques for nanoparticle and nanocomposite preparation including salt-matrix annealing, surfactant-assisted ball milling and severe plastic deformation have been invented and developed. Unconventional compaction methodologies including warm compaction and dynamic compaction are adopted.

A particularly important fundamental issue for nanostructured hard magnetic materials is the coercivity mechanism. It has been a century's puzzle to determine the coercivity limit which led to the Brown's Paradox. Our recent experimental results in ferromagnetic nanowires show that in nanoscale low-dimensional ferromagnets the paradox can be solved, opening a door for designing super strong magnets for advanced applications.

Biography:



J. Ping Liu received his Ph.D. degree at the University of Amsterdam, the Netherlands. He is a Distinguished University Professor at the University of Texas at Arlington. He has worked in research and development of permanent magnets and related magnetic materials in China, Europe, and the USA. His recent research has been focused on hard magnetic nanoparticles, thin films, and bulk nanocomposites, as reported in his more than 330 peer-reviewed papers (citation > 25000) including review articles and books *Nanoscale Magnetic Materials and Applications*, (Springer, 2009), *Skyrmions: Topological Structures, Properties, and Applications* (CRC Press, 2016), and *Permanent Magnets: The History and Future* (Science Press, 2020). He has supervised more

than 50 graduate students and postdoctoral researchers. Dr. Liu is an elected Fellow of the American Physical Society and the IEEE. He received the Outstanding Achievement Award at the 25th International Workshop on Rare-Earth and Future Permanent Magnets and Their Applications in 2018.