Contribution ID: **2** Type: **not specified**

Magnetic Field–Assisted Thermal Arc Plasma Synthesis of Core/Shell Fe-based Nanoparticles and Their Magnetic Properties

Core/shell Fe-based nanoparticles were synthesized using a thermal arc plasma technique. To investigate the influence of an external magnetic field, synthesis was carried out in a helium atmosphere at an arc current of 50 A and atmospheric pressure, both in the presence and absence of a transverse magnetic field of approximately 100 G applied perpendicular to the plasma plume.

Transmission electron microscopy revealed well-defined core–shell architectures with predominantly spherical nanoparticles, whose size distribution was noticeably influenced by the applied magnetic field. Structural phase formation and elemental composition were verified using X-ray diffraction and elemental mapping. Magnetic measurements performed at 300 K showed a clear reduction in saturation magnetization (from ˜69 to ˜44 emu/g) and remanent magnetization (from 18 to 12 emu/g) for samples synthesized under magnetic field conditions. Additionally, variations in zero-field-cooled and field-cooled magnetization behavior further highlight the role of the magnetic field during nanoparticle formation.

These findings demonstrate that magnetic field–assisted thermal plasma synthesis provides an effective route for tuning the structural characteristics and magnetic properties of Fe-based core–shell nanoparticles, offering potential for applications in data storage, biomedical technologies, and energy-related systems [1-2].

References :

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[2] Sargsyan et al., J. Mater. Sci. 60, 19770–19780 (2025).

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