

Core Loss Improvement of SiO₂ Coated Fe Alloy Powder

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Fe based alloy metal powder has been used for alternative current (AC) applications such as inductors and converters due to excellent soft magnetic property, high saturation magnetization with very low coercivity, of the powder. However, because of high electrical conductivity of Fe powder, eddy current generation under AC frequency is unavoidable and it becomes more serious with increasing AC frequency, leading to increased core loss, which limits its applications in high-frequency regime. In this regard, insulation-coating on the surface of Fe powder was utilized to block inter-particle eddy current paths so that reduces the eddy current loss. As such an effort, SiO₂ coating layer on the surface of Fe alloy powder was fabricated by the sol-gel process using ultrasonication, employing Tetraethyl orthosilicate (TEOS) as its precursor, in this study. TEOS concentration, coating time and ultrasonication condition were controlled for an optimization of processing parameters. Transmission electron microscopy (TEM) and Energy-dispersive X-ray spectroscopy (EDS) results revealed that SiO₂ coating layer was formed core/shell structure of Fe alloy/SiO₂. Magnetic properties including permeability and core loss were measured under AC frequency using toroidal powder core samples. Even though SiO₂ insulation coating decreased permeability, SiO₂-coated powder samples showed much improved core loss values due to decreased eddy current loss. Details will be presented for a discussion.

Keywords: Fe powder, SiO₂ coating, insulating coating, eddy current loss, core loss