

Magnetic properties of Fe metal powder coated with alumina by the sol-gel method

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In recent years, the soft magnetic composites (SMC) have attracted great interest of many researchers because of various potential applications for electromagnetic circuits, sensors, electromagnetic actuation devices, low frequency filters, induction field coils, magnetic seal systems, and magnetic field shielding. It is well-known that intolerably large high-frequency AC losses of magnetic metal powder can be effectively suppressed by their surface with an insulation coating. As such an effort, we tried to fabricate a core-shell structure composed of a Fe metal powder and layer of Al_2O_3 by the sol-gel method. The conditions of Al_2O_3 coating, such as reaction time, were controlled in order to obtain a uniform coating layer. Furthermore, the solutions were carried out using ultrasound treatment before alumina coating to avoid the agglomeration of Fe metal powder. To evaluate the AC losses of SMC, the magnetic core was fabricated by mixing and pressing Al_2O_3 -coated Fe metal powder with a resin. The analysis of the Fe metal powder coated with Al_2O_3 was carried out using field emission-scanning electron microscope (FE-SEM), transmission electron microscope (TEM), inductance analysis, and B-H curve analyzer. These results revealed that the Fe metal powder was uniformly coated with Al_2O_3 , and thus AC losses could be reduced by alumina coating.

Keywords: Eddy current, Insulation coating, Core-shell structure