Magnetic Characterization of Radio Frequency Heat Affected Micron Size Fe_3O_4 Powders: A Bio-Application Perspective

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Abstract:

Micron size Fe_3O_4 powders were chemically prepared and processed by radio frequency (13.56 MHz) oxygen plasma irradiation technique at different elevated temperatures using low radio frequency (RF) power level. Low magnetic field RF superconducting quantum interference device (SQUID) magnetization studies were performed up to a maximum magnetic field of 100 Oe, which was well below the magnetic field tolerance factor of human beings and at different temperatures (down to 5 K). Heat-treated powders in RF oxygen plasma showed significant changes in blocking temperature, magnetization and susceptibility, which are important parameters for bio-applications. It is observed that blocking temperature is decreased under identical RF heat treatment in oxygen plasma and noted to be dependent on average particle size. Microscopic rise in electron temperature during RF heating may likely to enhance the electron-hopping rate between Fe^{+2} and Fe^{+3} in the octahedral site of Fe_3O_4 molecular crystal structure, which in turn exhibit changes in blocking temperature including low field magnetization and susceptibility. These properties of Fe_3O_4 fine powder are likely to play important role in generating and processing biocompatible Ferro-fluid down to nanoscopic size for biomaterials applications.

Keywords: MAGNETITE FE3O4; RF HEAT TREATMENT; BLOCKING TEMPERATURE; MAGNETIZATION; SUSCEPTIBILITY