Analisis kurva histeresis dan struktur domain material feromagnetik CoFe dan CoFeB menggunakan simulasi mikromagnetik = Hysteresis loop and domain structure analysis of ferromagnetic materials CoFe and CoFeB by using micromagnetic simulation

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Abstrak

Telah dilakukan pengamatan terhadap kurva histeresis dan struktur domain pada lapisan tipis CoFe dan CoFeB model disk dan square yang diberi medan magnetik eksternal pada arah in-plane dan arah out-plane menggunakan pendekatan simulasi mikromagnetik. Simulasi mikromagnetik menggunakan perangkat lunak OOMMF berbasis Landau-Lifshitz-Gilbert LLG. Variasi ukuran model material CoFe dan CoFeB dilakukan pada rentang diameter 50 nm 500 nm dan ketebalan 5 nm dan 10 nm. Parameter simulasi menggunakan ukuran sel 2,5 x 2,5 x 2,5 nm3 dan faktor redaman = 0,05. Lapisan tipis CoFe model disk dan square menunjukkan sifat Perpendicular Magnetic Anisotropy PMA dengan menghasilkan koersivitas yang rendah ketika diberi medan eksternal arah out-plane. Hal menarik ditunjukkan pada lapisan tipis CoFeB model disk dan square dengan pemberian medan arah in-plane dan out-plane yang mengindikasikan pengaruh Boron mengubah nilai koersivitas CoFe menjadi lebih tinggi. CoFeB bersifat Perpendicular Magnetic Anisotropy PMA. Analisis terhadap besarnya medan nukleasi, koersivitas, dan waktu pembalikan menunjukkan adanya pengaruh perubahan ukuran size-dependent terhadap perubahan kurva histerisis lapisan tipis CoFe dan CoFeB. Pengamatan terhadap struktur domain CoFeB memperlihatkan terjadi perubahan struktur domain dari keadaan single domain SD menjadi multi domain MD dengan menunjukkan tipikal mekanisme pembalikan Neel wall.

.....Hysteresis loop and domain structure in thin film CoFe and CoFeB model disk and square are applied external field in two ways parallel and perpendicular has been investigate by using micromagnetic simulation. Micromagnetic simulation software OOMMF based on magnetization dynamic Landau Lifshitz Gilbert. Thin film CoFe and CoFeB size diameter ranging from 50 nm to 500 nm and variation thickness 5 nm and 10 nm. Size of cell size 2,5 x 2,5 x 2,5 nm3 and damping factor 0,05. Hysteresis loop of thin film CoFe disk applied parallel external field showed square loop hysteresis which showed typical in easy axis. In otherwise when applied perpendicular external magnetic field showed typical hysteresis loop in hard axis with low coercivity. Therefore, thin film CoFe disk and square has characteristic Perpendicular Magnetic Anisotropy PMA. Interestingly, thin film CoFeB disk and square applied by parallel and perpendicular magnetic field showed hysteresis loop which indicate that Boron changed coercivity from low 40 mT to high 780 mT. CoFeB showed Perpendicular Magnetic Anisotropy PMA. Moreover, coercivity, switching time, and nucleation field were shifted as the CoFe and CoFeB size varied size dependent. Observation domain structure of CoFeB showed change of domain structure from single domain to multi domain with switching mechanism in multi domain structure showed Neel wall typical.