Ion irradiation induced sub–100 nm ferromagnetic patterns

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9.7 cm

Focus ion beam (FIB) patterning of $Fe_{60}Al_{40}$ provides the potential to create arrays of microscopic ferromagnetic regions embedded in a paramagnetic matrix. As the consequence of low fluence irradiation such a method does not affect the surface roughness. Due to the ion damage distribution the phase transition from the chemically ordered B2-phase to the chemically disordered, ferromagnetic A2-phase is setup. The magnetic phase transformation is studied as a function of noble gases mass and is directly related to the number of displacements per atom (dpa) during ion irradiation. In case of heavy ions (Ar^+, Kr^+ or Xe^+) the phase transformation originates purely from ballistic nature of the disordering process. For light ions (He^+, Ne^+) the disordering conditions deviates from the former case. The bulk vacancy diffusion from dilute collision cascades, that leads to a partial recovery of the thermodynamically favored B2-phase, plays a major role. Furthermore, by means of moderately high temperature annealing (about 900 K) the paramagnetic phase is completely recovered due to the annealing-induced atomic reordering. Therefore, local ion irradiation may lead to a novel type of patterned recording media free from tribological and exchange coupling effects.

13.4 cm

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