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(001) Oriented $L1_0$ FeCuPt for Heat-Assisted Magnetic Recording[1]

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High magnetic anisotropy materials are critical to key technologies such as ultrahigh density magnetic recording and permanent magnets. Among them, ordered FePt alloys in the $L1_0$ phase are particularly sought after, for the emerging heat-assisted magnetic recording (HAMR) media. However, the highly desirable properties are associated with the tetragonal $L1_0$ phase. Key challenges exist in the high annealing temperature necessary to transform the as-deposited disordered cubic $A1$ phase into the ordered tetragonal$L1_0$ phase and the ability to maintain the magnetic easy axis perpendicular to the film. We have achieved (001) oriented $L1_0$ FeCuPt thin films, with magnetic anisotropy up to 3.6 x 10^7 erg/cm^3, using atomic-scale multilayer sputtering and rapid thermal annealing (RTA) at 400 °C for 10 seconds, which is much more benign compared to earlier studies [1]. The artificial ordering in the multilayer structure and a significant tensile stress exerted by the underlying Si/SiO_2 during RTA facilitate the formation of (001) oriented $L1_0$ phase. The $A1$ to $L1_0$ phase transformation has been investigated by x-ray diffraction and the first-order reversal curve (FORC) method [2]. The $L1_0$ ordering takes place via a nucleation-and-growth mode. Traditional x-ray diffraction is not always reliable in generating a true order parameter, due to non-ideal crystallinity of the $A1$ phase in some of the samples. A magnetization-based $L1_0$ phase fraction is extracted, providing a quantitative measure of the $L1_0$ phase homogeneity [3].

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