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Magnetic Anisotropy in Surface Supported Nanostructures

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From a fundamental point of view, only three issues define the ultimate density limit of magnetic information storage. First, the magnetic anisotropy energy K has to be beyond 1.2 eV for the memory to nonvolatile at 300 K. Second, the write and read signals have to be uniform in order to enable the ultimate limit of single particle bits. Third, mutual interactions between adjacent bits have to be minimized, which is achieved for an out-of-plane easy axes.

We present measurements on surface supported nanostructures which are considered as model systems for the study of magnetism in nanostructures and for the exploration of the ultimate density limit of magnetic information storage. We report on the evolution of K as a function of size, starting from single atoms, and going up in size almost atom by atom for Co on Pt(111) using XMCD measurements. Monomers have 200-times the Co_{hcp} bulk anisotropy. Larger 2D nanostructures are investigated by MOKE confirming a strong coordination effect on the anisotropy energy. For Co/Pt(111) the low-coordinated edge atoms have 20-times the bulk anisotropy and favor out-of-plane magnetization. Currently, the best homogeneity of magnetic properties is obtained for Co islands self-assembled on Au(788). The temperature dependence of the zero-field susceptibility χ shows that mutual interactions between the monodomain particles are absent at a density of 26 Tera particles/in². We finally present data on bimetallic (FeCo, FePt, CoPt) nanostructures.