# Condensed Matter Physics Institute Seminar

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# Control of microstructure of FePt-X (001) films for HAMR through interface modification and doping

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The main challenge of the application of $L1_0$ FePt thin films as magnetic recording media is the simultaneous fabrication of FePt (001) thin films with high perpendicular anisotropy and small grain size. $L1_0$ FePt (001) granular films with grain size of 5-6 nm were achieved on MgO underlayer by doping C and Ag.However, RF sputtering of the insulating MgO underlayer layer is not preferred for industrial applications due to its low deposition rate and particle contamination on the media surface. The large opening-up of in-plane hysteresis loop was observed in the FePt film grown on polycrystalline MgO underlayers that would increase the switching field distribution and thus reduce the signal-to-noise ratio. We found that the large opening-up of the in-plane hysteresis loop was caused by the smaller surface energy of MgO (1.1 $J/m^2$) with comparison with FePt (2.9 $J/m^2$) which resulted in a large contact angle between FePt grain and MgO and is not favorable for epitaxial growth. The situation became worse when polycrystalline MgO underlayer was used. Any small deviation of texture of underlayer and roughness change will cause deviation of the crystal orientation of FePt overlayer from film normal (001) orientation. Based on this, we proposed to use TiN and TiON as intermediate layers or underlayers to promote the (001) texture of FePt film and grain isolation. The highly (001) textured FePt-$SiO_2$-C films with high magnetocrystalline anisotropy and in-plane hysteresis loops with small opening-up and well-isolated grain with size of $5.7 \pm 0.9$ nm. With introducing new doping materials, we have developed columnar structured FePt-X (001) films with well-isolated small grains and large coercivity on TiON intermediate layer. The FePt grains with size of 5.6 nm showed very good columnar structure with aspect ratio of around 2.6. The out-of-plane coercivity of the film deposited at $500^oC$ is as high as 23.2 kOe.