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Surface Magnetism of Fe overlayers on Pt(110)

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Ferromagnetism in films of transition metals a few layers thick has drawn a lot of attention for the last two decades and it has been considered to be quite well understood before the use of scanning tunneling microscope(STM). One of the most well known systems is Fe on Cu(001) substrate. We need the detailed atomic picture to explain the ambiguous magnetic properties of the systems in interests. Recently there are several trials to make magnetic nano wires. Using vicinal surface with the step-flow growth is one of the method to make the nano wire and Co on Cu(111) system shows well grown Co wires though they are not mono-atomic. In addition to this nano wire fabrication, interesting question comes from the magnetic anisotropy in this wire. For the magnetic measurement or the possible application in magnetic device, we need to magnetize this wire. Very simple but important question would be the easy axis in this system.

The energy of a ferromagnet depends on the direction of the magnetization relative to the structural axes of the material so that magnetic anisotropy can be changed by the presence of surface and interface due to its modified electronic structure. Also the strain applied to the overlayer can change its magnetic anisotropy via the magnetoelastic interaction. Reversibly, this anisotropy can be controlled by the substrate structure that we use. This magnetic anisotropy engineering is quite important as we make the nano structures down to 1 or 0 dimention.(wires or dots)

Surface Magnetism has been studied systematically on Fe overlayers on Pt(110) surface using surface magneto-optic Kerr effect(SMOKE). Using the Pt(110) substrate is based on the possibility of making Fe nano wires at low coverage(0.5ML) since this surface shows missing row (2x1) reconstruction. If the Fe atoms are filled in this missing row at this coverage, mono-atomic Fe wires can be formed though it one Fe atom is surrounded by three neighboring Pt atoms.

The Fe overlayers were grown on Pt (110) surface by e-beam evaporation. The substrate were cleaned by 1 keV Ar+ ion sputtering followed by the annealing up to 1100K. The surface structure of substrate and Fe overlayer were confirmed by low energy electron diffraction(LEED) and scanning tunneling microscope(STM). SMOKE measurement had been done at polar and longitudinal geometry.

At room temperature, the SMOKE signal starts to show up at the coverage of 3ML. It is quite interesting to note that there is only a longitudinal signal. Polar signal is not observed at all in all Fe coverages. Low coercivity in longitudinal geometry can be used to rule out the artifacts from the polar geometry slightly misaligned. Strong in-plane anisotropy in thin layers can be explained by the uniaxial in-plane anisotropy present in our sample. We would explain all the details on the magnetization vs. coverage. Annealing this film upto 500 K could enhance the ordering. The coercivity in regards to the film morphology will be discussed in this system.