

Magnetic and Optical Films Made by Pulsed Laser Deposition

Personnel

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We have established a Thin Film Laboratory which includes a Pulsed Laser Deposition (PLD) system and a UHV Sputter/analysis system. In PLD, a high energy excimer laser is used to ablate a target, releasing a plume of material which deposits on a substrate to form a thin film. PLD is particularly useful for making complex materials such as oxides because it preserves the stoichiometry of the target material. We have used PLD to produce films of Cr and CoCrPt alloys to compare with films produced by sputtering, in order to understand the importance of the plasma on film microstructure development, in particular the influence of energetic bombardment on the formation of the Cr (200) / CoCrPt (1120) preferred orientation. We have also been using PLD to deposit a variety of oxide films for photonic and magnetic devices. These materials include iron oxide, which can adopt one of three different ferri- or antiferromagnetic structures depending on deposition conditions, chromium dioxide, which is a ferromagnetic oxide, bismuth iron garnet, which is useful for magneto-optical isolators in photonic devices, and silica, a waveguide material.

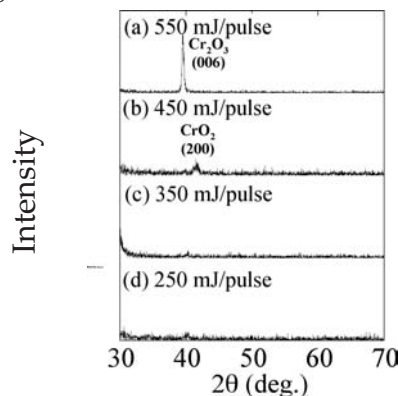


Fig. 11: X-ray diffraction spectra from 40-60 nm thick CrO_x films grown onto (111) Si substrates at 390 °C using pulsed laser deposition. In (b) the ferromagnetic CrO_2 phase is visible.

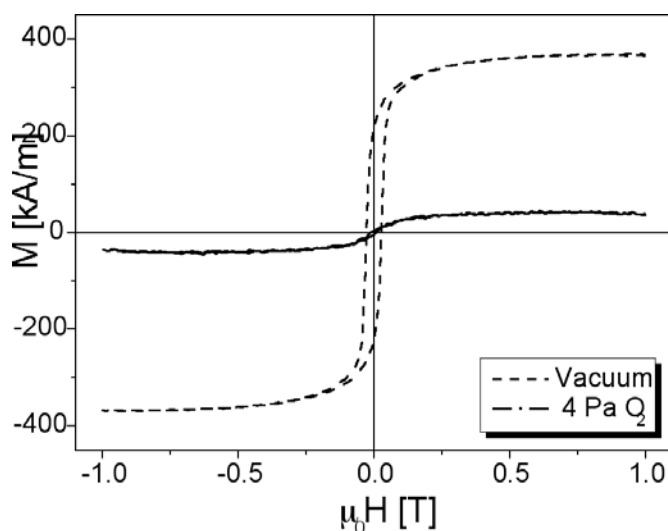


Fig. 12: Hysteresis loops from iron oxide films deposited on Si (001) in vacuum and in O_2 , measured in the in-plane direction. The film depositions were carried out at 400°C, with laser energy of 500 mJ/pulse and 25 Hz. The film grown in vacuum is ferrimagnetic $\gamma\text{-Fe}_2\text{O}_3$, while the one grown in oxygen is $\alpha\text{-Fe}_2\text{O}_3$. Ideally the α -phase should be antiferromagnetic, but small deviations from stoichiometry lead to a low magnetic moment.