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Development of New Apparatus for Resonant Soft X-ray Scattering

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X-ray scattering is one of the widely used experimental techniques. It has unveiled the structural properties of materials, such as film and crystal, in addition to magnetic and electronic structure. In particular, physical phenomena of materials composed by 3d transition metal are recently spotlighted (e.g. manganite, superconductor, multiferroic). Since soft x-ray region (500eV ~ 1500 eV) covers L-edge of 3d metal, soft x-ray scattering is the best probing technique to investigate many kinds of magnetic materials and systems. For this reason, several research groups developed soft x-ray scattering and reported various interesting results. In here, we report the development of new apparatus for resonant soft x-ray scattering which has been built at 2A beamline in Pohang Light Source (PLS). Rotation of the sample (Θ) and detector (2Θ) is realized by two differentially pumped rotating platforms with motors. A moveable aperture and 0.5 ~ 1 mm slits were placed in front of the sample and detector, resulting the experimental resolution (ΔQ=0.007 $Å^{-1}$). An open-flow helium cryostat allows cooling down to 10 K and a rotating electro-magnet guarantees about 0.2 T.

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Magnetic and Optical Properties of NiO Ffilms Prepared by the Oxidation of the Metallic Ni

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Nickel oxide(NiO) is a semiconductor with the band gap energy of 3.6-4.0 eV at 300 K and has a cubic crystal structure with a lattice constant of 4.194 Å. It is being widely used in spin devices as a pinning layer because of its antiferromagnetic properties with the Neel temperature of 525 K. Here we report the magnetic and optical properties of polycrystalline NiO thin films prepared by the thermal oxidation of metallic Ni. The 2000 Å Ni metal films were deposited on fused silica substrates at room temperature by DC magnetron sputtering with an Ar pressure of 50 mTorr. After deposition, the films were removed and placed in a thermal oxidation furnace at temperatures between 300℃ and 1000℃ for 30 minutes. In order to characterize the crystal structure and morphology of these films, we performed X-ray diffraction (XRD) and atomic force microscopy (AFM) studies. As the annealing temperature increases, the particle size increases, as expected, resulting in the sharpened and enhanced XRD diffraction peaks. From optical absorption spectra, we determined the energy gaps of these films. Particle size dependent magnetic and optical properties will be discussed in detail.

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