W07

Design, Layout, and Electron optics simulation of SEMPA

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Recently, magnetic domain observation has become one of the mostly required process in many fields of science and technology. Especially the rapidly growing interest in the physics of nano-structured magnetic materials, the ever increasing recording density of conventional magnetic storage devices, and the development of future nano-scale magnetic and spin-electronic devices are the major sources of this focussed interest.

Among several techniques for magnetic domain observation, a spin-polarized scanning electron microscope, denoted as SEMPA or spin-SEM, is very effective technique for magnetic structures at the surface. It can detect magnetization direction quantitatively, obtain magnetization information independent to sample topography, is appreciable to thick sample and can image 3-dimension simply inserting spin rotator. This technique is based on analyzing the spin polarization of secondary electron created from the sample surface of ferromagnetic materials by probe electron beam. Probe beam size determines the spatial resolution and polarization of secondary electron is strongly dependant on the energy of secondary electrons; highest at lowest energy and intensity of secondary electrons also highest at lowest energy. Therefore it is important to select appropriate energy window. Typically secondary electron collector has electrode potential for the energy window from 0 to 10 eV.

We have designed SEMPA; secondary electron collector, transfer-lens system, spin rotator, and spin detector(Mott-polarimeter) with the use of commercial SEM, Hitachi SN-2250N. Specially designed secondary electron deflector to collect as much as secondary electrons and minimize the working distance, is shown Fig 1. Electron optics in the this system has been studied by electron optics simulation program SIMION 7.0 to determine electrostatic potential of each electrode for optimized operating condition. Simulation show that probe electron beam trajectory travels inside the deflector was distorted maximum 3% at the sample surface by inhomogeneous field from electrodes. Secondary electrons projected from the sample surface has the energy window from 0 to 10 eV are mostly collected to transfer-lens by controling electrode potential. Electron transfer lens also can change focus range simply changing their electrode potential. The spin rotator, electron spin detector and data acquisition system will also be introduced.

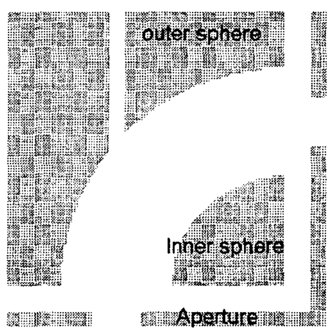

Fig 1. secondary electron collector, 90° deflector.