High Brightness and Highly Spin-polarized Low Energy Electron Microscopy

Takanori Koshikawa[1,] Masahiko Suzuki[1], Kazue Kudo[2], Kazuki Kojima[3], Tsuneo Yasue[1], Noriko Akutsu[1], Agerico Dino[3], Hideaki Kasai[3], Ernst Bauer[4], Tsutomu Nakanishi[5], Jin[6] and Yoshikazu Takeda[7]

1. Osaka Electro-Communication University, Osaka, Japan,
2. Ochanomizu University, Tokyo, Japan,
3. Osaka University, Osaka, Japan,
4. Arizona State University, Tempe, USA
5. School of Science, Nagoya University, Nagoya, Japan
6. KEK, Tsukuba, Japan
7. Aichi Synchrotron Light center, Aichi, Japan

E-mail: dirk.vandyck@uantwerpen.be

We have already developed a novel very high brightness and high spin-polarized low energy electron microscope (SPLEEM) [1-3]. Our developed SPLEEM can make us the dynamic observation of the magnetic domain images possible. However the size of the spin-polarized electron gun is large and we have developed a new compact spin-polarized electron gun with a new idea. In principle two devices are necessary to operate 3-dimensional spin direction; one is a spin manipulator which changes the out-of-plain spin direction and another one is a spin rotator which can change the in-plain spin direction. We have proposed a multi-pole Wien filter which enables 3-dimensional spin operation with one device as shown Fig.1 [4].

Current induced domain wall motion is a key phenomenon to realize novel spintronics devices such as a race-track memory (IBM) and a domain wall motion magneto-resistive random access memory (NEC). It has been indicated that domain walls in nanowires with perpendicular magnetic anisotropy can move with lower current density than those with in-plane magnetic anisotropy. Multilayer [$CoNi_X$] multi-layer is known to exhibit perpendicular magnetic anisotropy and is expected as a material for the devices with low operation current]. We investigated magnetic property during growth of the [$CoNi_x$]y multi-layer with our high brightness and highly spin-polarized SPLEEM [1-3]. We will also reproduce the magnetic domain pattern formation of the surface of Co/Ni multilayers by numerical simulations based on the Landau-Lifshitz-Gilbert (LLG) equation, which describes the dynamics of local magnetization. Fig. 1 shows experimental and simulation results of magnetic domain images of multilayers of pairs of [$CoNi_2$] on W(110) [5,6]. The numerical simulations well reproduce the magnetic domain patterns observed in the experiments.

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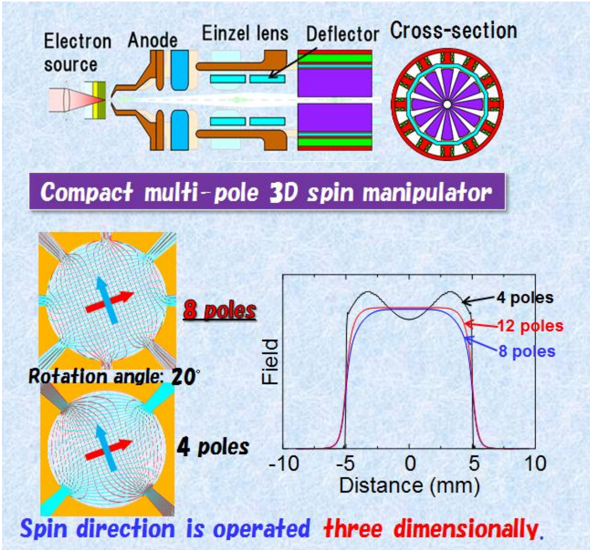

Fig.1 3D spin manipulator

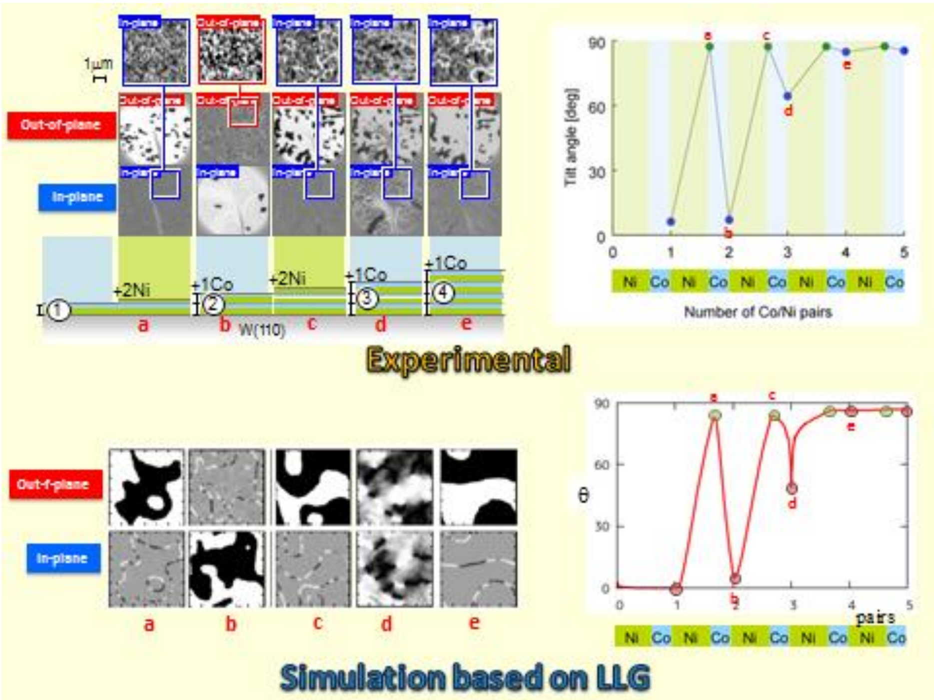

Fig.2 Magnetic domains of Co/Ni multi-layers