

# Stereo-PEEM for Three-dimensional Atomic and Electronic Structure of Microscopic-materials

Hiroshi Daimon, Hiroyuki Matsuda, Laszlo Toth, Fumihiko Matsui

*Nara Institute of Science and Technology (NAIST), 8916-5 Takayama, Ikoma, Nara  
630-0192, Japan,*

*CREST, Japan Science and Technology Agency, Saitama 332-0012, Japan*

A new PEEM (photoemission electron microscope) system Stereo-PEEM (Fig. 1) to obtain three-dimensional (3D) atomic structure as well as 3D electronic structure in addition to the image of microscopic-materials is described. Stereo-atomscopy [1] is a newly developed method to take stereo-photograph of atomic arrangement by measuring two-dimensional photoelectron angular distribution (PEAD) excited by circularly polarized soft x-rays. The forward-focusing peaks in PEAD rotate by the same amount as the parallax in a stereo-view. These patterns in a wide-angle PEAD can be used as photoelectron diffraction or holography patterns, and enable us to analyze atomic structure in detail. The display-type spherical mirror analyzer (DIANA) can show these patterns directly on the screen without any computer process. When we use ultraviolet light as an excitation source we can obtain 3D band structure or Fermi surface mapping of valence band. Recent PEEM can also display Fermi surfaces, but cannot display stereo photograph or photoelectron diffraction patterns in a wide angle because its acceptance angle decreases to around 15 degrees when the kinetic energy increases to around 1000 eV.

We have succeeded to develop an aberration-free large acceptance angle objective lens [2,3]. Combination of this objective lens and lens system can be used to make PEEM image with large acceptance angles even at high kinetic energies. When we select electrons from microscopic-area using field aperture, it realizes a Stereo-PEEM to obtain three-dimensional atomic and electronic structure of microscopic-materials. Recent result of the lens system is described.

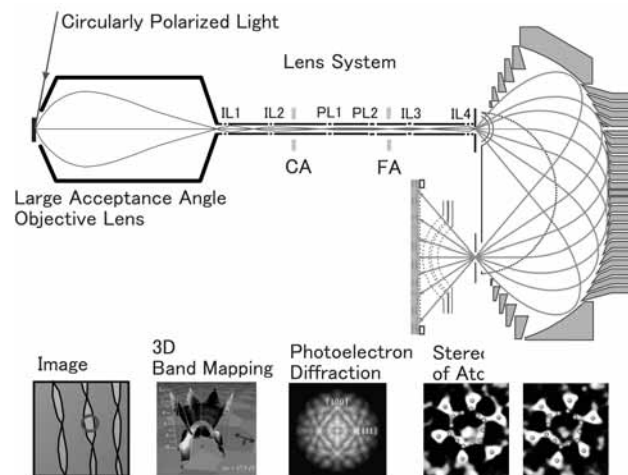


Fig.1 Schematic drawing of Stereo-PEEM

[1]H. Daimon, Phys. Rev. Lett. 86, (2001) 2034.

[2] patent: PCT/jp2004/016602, Japan 2004-208926

[3] H. Matsuda, H. Daimon, M. Kato and M. Kudo, Phys. Rev. E 71, 066503 (2005)