High potential of photoelectron momentum microscopy (PMM) in normal and grazing incidence excitation at UVSOR facility and resonant inelastic X-ray scattering for studying spin electronic states in both conductive and nonconductive materials

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After the experience of SP-PMM experiments in Max-Planck Institute for Microstructure Physics in Halle and Elettra together with Dr.C.Tusche in 2013-2015, I introduced a single hemispherical electron energy analyzer type PMM, Kreios-1, to UVSOR synchrotron radiation Facility of Institute for Molecular Science, Okazaki, Japan in 2020 from SPECS. The commissioning took quite long time because no technician can visit Japan from SPECS by the COVID-19. On the other hand, we could handle the system by ourselves and could see the details of the instruments. After getting some nice results, we decided to upgrade the system to S-arranged double hemispherical electron energy analyzers(DHDAs) type DHDAs-PMM in 2020.

Again various new problems must be solve by ourselves, because SPECS staff could stay only for a short time for commissioning. So again we (Prof.F.Matsui and I) could have rare chances to know the details of the DHDAs-PMM.

We could also intensively modify the beam line configuration of UVSOR and made it possible to do the normal incidence excitation DHDAs-PMM experiment as well. Then we could publish many interesting papers till February 2024. Due to the simpler optical configuration, theoretical analyses became much simpler than the 68°incidence configuration. The spin analyses may become much more reliable if we get the results in both configurations with normal and off-normal incidence light excitation.

Now installation of the 2D spin filter is going on and we expect to get fantastic SP-PMM results at normal and 68 incidence soon.

I am also planning to do the measurements under the various conditions such as 1)remanent magnetization, 2)under H field, 3) under electric field on the sample, 4) under uniaxial strain. Since the spin detection efficiency is more than one million times higher than the so far world bet single channel spin detection by use of Fe-O VLEED spin detector developed by my former students Prof.T,Okuda and Prof.A.Kimura, new era of science and device development will soon start on our planet with adding the information on non-conductive materials by use of X ray resonant inelastic scattering for which I have already developed H, E and uniaxial strain application instruments.

So by combining SP-PMM and operand RIXS studies and spin resolved scanning tunneling microcopy and spectroscopy (SP-STM/STS), I would like to enjoy the frontier science and engineering in the next twenty years solving various serious problems of device development.