

X-ray Nanodiffraction for Microstructural Image and the Applications on Material Science

Ching-Yu Chiang (蔣慶有), Chia-Hsien Lin, Shang-Jui Chiu, Ching-Shun Ku*

National Synchrotron Radiation Research Center, 101 Hsin-Ann Road, Hsinchu Science Park, Hsinchu, Taiwan
csku@nsrrc.org.tw

Abstract

The X-ray Nanodiffraction Beamline (XND) at BL-21A in Taiwan Photon Source (TPS) was dedicated to use the focusing white/mono-beam diffraction for structural analysis. With 80x80 nm focus x-ray beam onto the sample, users could obtain the 2D distribution of crystal phases, orientation, residual strain, stress and dislocation maps for materials in a complex form without distorting the sample geometry during measurement. Furthermore, this end-station also provided many complementary tools. Tetra-probe stages could deploy several scanning probes to collect optical, electrical, surface properties with tens of nanometer resolution of specimens; the x-ray fluorescence detector provides elemental information and the cryo-stage integrated with heater for temperature dependence experiments. Particularly, it is also the first time in synchrotron history to integrate an online scanning electron microscopy (SEM) as a navigator. With spatial resolution down to 4 nm, it is able to find out the interest region with tiny structure on samples and also arrange the position for different probes. This end-station can function either in vacuum or ambient environments depending on the user's demands. In summary, TPS 21A end-station will provide not only 2D-XRD but also nano-XRF, nano-XAS, nano-XEOL, and SEM information for diverse research programs. This talk will introduce the capabilities and the commissioning results of XND, also as well as some experimental results from nano-sized structural determination [2], strain map on semiconductor device, phase study on 2D materials to demonstrate the unique of TPS 21A end-station.

Keywords – Nanodiffraction, Nanobeam, Microstrain

References

1. X. Chen, C. Dejoie, T. Jiang, C. S. Ku, and N. Tamura, *MRS Bulletin*, 41, 445, 2016.
2. Yang Lua, Ching-Yu Chiang, Eugene Huang, *Appl. Mater. Today*, 20, 100707, 2020.