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Capturing interface processes at the atomic scale by high-speed surface X-ray diffraction

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Surface X-ray diffraction (SXRD) is one of the most powerful methods that can determine the atomic structure of buried interfaces non-destructively. It is widely used to analyze the structure of solid-liquid and solid-solid interface to understanding the interface processes such as electrochemical reaction and thin film growth. A drawback of SXRD is that the measurements are often time-consuming: the data acquisition time is several tens of minutes or more even when a state of the art two-dimensional detector is used, which is in most cases longer than the relaxation time of the structural changes. Capturing the dynamical behavior of interfaces with a sufficient temporal resolution still remains challenging.
We have developed a high-speed technique which can acquire a wide range of SXRD profile at once within seconds or less [1]. The method uses an energy-dispersive convergent X-rays, instead of a conventional monochromatic collimated X-rays. The combination use of the energy-dispersive X-rays and a two-dimensional detector allows the simultaneous acquisition of a SXRD profile without moving the specimen and detector, enabling the real-time monitoring of interface processes [2, 3].
In this talk, we show the capability of the high-speed technique for capturing the atomic-scale processes at buried interfaces: structural change of Pt(111) electrode surface during electrochemical decomposition of methanol, and the atomic-scale growth process of topological insulator Bi2Se3 thin film.

References

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