Feasibility Study of HI-ERDA using KAHIF for Nuclear Application Material Surface Analysis Research

Yong-Sub Cho[1*], Sung-Ryul Huh[1], Dae-Sik Chang[1], Sun Ho Kim[1], Kye-Ryung KIM[2], Dong Won Lee[1]

[1]Nuclear Physic Application Research Division, Korea Atomic Energy Research Institute, Daejeon, Republic of Korea
[2]KOMAC, Korea Atomic Energy Research Institute, Gyeongju, Republic of Korea
[*]E-mail: choys@kaeri.re.kr

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Elastic Recoil Detection Analysis (ERDA) is a field of Nuclear Analytical Technique (NAT) based on accelerators, and is a type of Ion Beam Analysis (IBA) to obtain elemental composition and depth distribution in thin films. Rutherford backscattering spectrometry (RBS) measures the ions that are backscattered when the accelerated light ions are irradiated onto the surface, and the ERDA method measures the surface atoms recoiled by the accelerated ions. In the case of RBS, mainly heavy elements can be measured, whereas in thecase of ERDA, there is an advantage of being able to measure light elements at the same time. In the case of Light Ion ERDA (LI-ERDA), the distribution of hydrogen in the thin film is mainly measured using ahelium beam. In the case of Heavy Ion ERDA (HI-ERDA), it has the advantage of being able to measure a) from light to heavy elements atthe same time, b) with high sensitivity, and c) with low ion beam intensity. There is a disadvantage of increasing the energy of ions in order to measure deeper. Mainly, heavy elements such as iodine are made into negative ions, and several MV tandem accelerators are used to obtain an ion beam of several tens of MeV for ERDA. The Korea Atomic Energy Research Institute is operating the KAERI Heavy Ion Facility (KAHIF) based on a linear accelerator that can accelerate various heavy ions up to 1 MeV per nucleon. Taking advantage of the high current feature, which is the advantage of linear accelerators, it is mainly used for research on irradiation damage of nuclear application materials, especially nuclear fusion materials. When xenon is extracted from this accelerator, a 130-MeV xenon beam can be obtained, and when ERDA is performed with this beam, elemental composition analysis in the depth direction is possible for thin films in various fields. In particular, in the field of nuclear fusion,various elements such as hydrogen, deuterium, boron, carbon, nitrogen, molybdenum, and tungsten contained in plasma-facing components can be analyzed simultaneouly, which is expected to contribute a lot to nuclear fusion research. In this study, the feasibility of ERDA using KAHIF is reviewed. We would like to report the results of a review on adding detectors for ERDA to an existing sample irradiation chamber and adding a Time-of-Flight (ToF) device for improved performance.

Fig. 1. KAERI Heavy Ion Facility (KAHIF)

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