Analysis of Plasma Material Surfaces by Means of Low Energy NRA

K. Ochiai, N. Kubota, K. Kondo and T. Nishitani.
Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken 319-1195, Japan

Nuclear reaction analysis with ion beams is useful to obtain the light nuclei depth profiles in plasma facing materials. JAERI/FNS has carried out the measurement of the deuterium and carbon-12 depth profiles in the JT-60 carbon tile and deuterium, tritium, lithium isotope depth profiles in a TFTR carbon tile by means of NRA with deuterium ion beam.

The probe beam was a deuteron beam and its energy and current density are adjusted between 150 and 390 keV and 0.1-1μA/cm^2 respectively. In case of carbon sample, the detectable depth is about 1.5 μm by 350 keV deuteron. The size of beam is to 6.5 mm in diameter. A silicon solid state detector (SSBD) with a depletion layer of 200 μm, was used to detect high energetic charged particles induced with nuclear reactions. The SSBD energy resolution was determined with a standard α-source (Am-241: E_α = 5.486 MeV) and the FWHM was below 40 keV. To obtain the depth profiles of the deuterium, tritium, lithium-isotope and carbon-12, the proton, triton and α emitted from D(d,p)T, T(d,α)n, ^{6}Li(d,2α) and ^{12}C(d,p)^{13}C nuclear reactions induced between deuteron beam and the nuclei in the JT-60 and TFTR tiles were measured. These nuclear data libraries of the cross section values for the these reactions were used FENDL-2 and the S-factors reported from some experimental data.

From the measurements, we have obtained depth profiles of light nuclei in a JT-60 and TFTR tiles. The deuterium retention on a JT-60 tiles surface was about 1 x 10^{16} D/cm2 and it was found that the ratio of deuterium and carbon retention (D/C) was about 3 %. Also, in case of TFTR tiles, It was found that deuterium, tritium and lithium-6 retentions were about 3.8 x 10^{17} cm^{-3}, 7.2 x 10^{19} cm^{-2} and 3 x 10^{17} cm^{-3} near the surface (~1.2 μm depth) respectively. On this symposium, we mainly introduce the methodology by the NRA.