Advantages and limitations of IEE ERDA with the nuclear microprobe

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Contrary to the ERDA setup with a stopping foil, in IEE (Ion-Induced Electron Emission) ERDA recoiled target atoms and scattered projectiles are both detected in the same particle detector after passing through a set of very thin C foils. Separation between recoiled and scattered ions (particle identification) is based on the fact that the number of electrons emitted from the foils and collected with MCP detector is roughly proportional to the stopping power of the particles in the foil. As C foils are very thin, their influence on total energy resolution is negligible. Due to large reduction of energy loss straggling, a new IEE ERDA system mounted on the nuclear microprobe can be used for 3D hydrogen profiling with superior depth resolution compared to the simple foil ERDA. As forward scattered and recoiled atoms are collected in the same particle detector, normalization needed for quantification can be done without using additional SB detector.

However, well defined and rather small IEE ERDA solid angle compared to solid angles typically used for foil ERDA, results in a need for increased ion beam currents if good sensitivity for H detection needs to be achieved. High beam currents focused to few microns spot size lead to rather high current densities that can cause radiation damage and H loss from the sample. In this work, limitations of current densities vs. sensitivity have been studied for several different sample types containing H and showing different degrees of H stability under beam irradiation. By positioning IEE ERDA system at 45° instead of 30°, better sensitivity can be obtained due to larger cross sections without significant deterioration in depth resolution.