Ion Beam Analysis including ToF ERDA of complex composition layers

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Several analytical methods based on different physical principles are used to determine the depth distribution of elements in the surface layers of materials. These are, for example, XPS, AES, EDX, SIMS, ICP-MS, Raman spectroscopy, etc., while each of the methods has its own specifics, advantages and disadvantages. When developing new materials such as radiation, high temperature and corrosion resistant, hard coatings, next-generation electrode materials for various applications in electrochemistry, but also in semiconductors field, etc., it is indispensable the knowledge of detailed elemental composition from surface to a depth of several micrometers. For the quantitative determination of elemental depth profile of such samples, also established quantitative IBA (Ion Beam Analysis) methods such as RBS, EBS, NRA, PIXE and ERDA are applicable, the advantage of which is that they are considered to be absolute and non-destructive. Each of these methods is advantageously used to analyze a certain range of elements, sometimes depending on the combination of other elements present.

If the analysis of thin layers with a complex composition is required, e.g. with a content ranging from heavy elements such as W, through rare earths such as Ta, Hf to Ti, with a content of light elements ranging from Si through Mg, N, B to H, it is already quite a challenging task. In such a case, it is necessary to use a combination of several, many times even all of the above-mentioned IBA methods. Then iterative evaluation of separate IBA data is necessary, which is a more demanding and time-consuming activity, but the output is depth profiles of layers with a complex elemental composition with a thickness from few nanometers up to 3 micrometers.

The recently commissioned ToF-ERDA measurement IBA system significantly expands the analytical possibilities of thin layers up to micrometer depth. Using the primary analyzing 50 MeV Au beam, the depth profiles of all elements from W to H can be obtained within a single measurement. On the examples of multi-elemental samples analysis, the gained results, difficulty of measurement and evaluation of ToF-ERDA on the one hand, and of the combination of the other above-mentioned IBA methods are compared and evaluated.

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