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ION IMPLANTATION OF RADIONUCLIDES AND THERMODESORPTION SPECTROSCOPY FOR CHARACTERISATION OF NEW MATERIALS

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Physico-chemical properties of solids are determined, at a large degree, by the structure of thin surface layers (their thickness being about 100 nm). To predict the behaviour of materials (such as catalysts, adsorbents, ceramics, etc) in chemical reactions, it is necessary to determine the mobility of defects during the morphology formations of surface layers and their changes. A combination of methods of ion implantation of gaseous radionuclides and thermodesorption spectroscopy is used in the study of defects in both crystalline and non-crystalline materials.

In this paper micro-RBS using α-particles $^{4}He^{+}$ are applied to the characterisation of thin surface layers, catalysts based on oxides of Th, Y, Al, and Ti, and polymers (polyethylene, polypropylene, poly-4-methylpentene-1). The heavy rare gas radon ^{222}Rn is used as a radioactive diffusion gas probe.

A combined apparatus, which enables the implantation of accelerated 100 KeV radon ions into solids, the measurement of angular distribution of 5-6 MeV α-particles and a continuous analysis of the radioactive inert gases released under thermal, radiation, mechanical and chemical effects on the materials, is described.

The analysis principles of the thermoinsulated release of radioactive inert gas, which are based on measuring noble gas migration in solids, are given. The potential, and various applications, of this method are demonstrated, e.g. the determination of inert gas mobility in oxides, diagnostics of materials, investigation of solid-state processes in hydroxides and oxides (generation and annealing of defects, dehydration of hydroxides, solid-state transformation etc.), as well as characterisation of different types of defects in thin layers of crystalline polymers and membrane materials.

The methods presented in the paper can be used for the investigation of other types of reactions of solids, e.g. those based on the solid-gas or sold-liquid interactions.

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