Materials Research by Nuclear Reaction Analysis

José A. R. Pacheco de Carvalho[1], Cláudia F. F. P. R. Pacheco[1], António D. Reis[1]
[1]*APTEL Research Group, Department of Physics, University of Beira Interior, R. Marquês d' Ávila e Bolama, 6201-001 Covilhã, Portugal*

Several complementary techniques have been developed for surface analysis of materials. Nuclear techniques, using low energy MeV ion beams, give absolute values of concentrations of isotopes and elements for a few microns close to the surface. Their main applications have been given in areas such as scientific, technologic, industry, arts, archaeology and medicine [1-7]. Tracing of isotopes with high sensitivities is possible by nuclear reactions.The energy analysis method is used for ion-ion reactions. At a suitable bombarding energy, an energy spectrum is recorded of ions from reaction events occurring at several depths in the target. Such spectra are computer predicted and compared to data, providing target composition and concentration profile information [4-7]. A computer program has been developed in this context, mainly for flat targets [4-6]. The non-flat target case arises as an extension. Depth profiling of light nuclei e.g. ^{12}C is made by the $^{12}C(d,p_0)^{13}C$ reaction in a thick flat target of extremely high purity pyrolytic graphite. Experimental details are available [4]. The simulations used published nuclear data, namely for differential cross section and stopping power. A very good computed fit was reached to spectral data obtained at E_d=1.86 MeV and Θ_L=165°, permitting to find a ^{12}C step concentration profile along a high depth of X_1= 15 μm. The result would be difficult to reach by other techniques, evidencing nuclear reaction analysis as a highly powerful analytical tool for non-destructive surface analysis of materials.

References:
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Acknowledgement: Supports from University of Beira Interior and FCT (Fundação para a Ciência e a Tecnologia)/PEst-OE/FIS/UI0524/2014 (Projecto Estratégico-UI524-2014) are acknowledged.

Presenting Author: José A. R. Pacheco de Carvalho, pacheco@ubi.pt