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Development of Thin Layer Activation for Wear Measurement

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Since the early 80s, when a cyclotron was installed in our laboratory, besides the fundamental research also application areas have been established. In the first years of operation a relatively big amount of radioactive isotopes was produced for medical purposes. Parallel with the medical isotope production, a number of other isotopes has been developed for industrial and agricultural purposes. These isotopes were intended to use for radioactive tracing. During the cooperation of national and foreign companies and research institutions the idea of using the radioactive tracers for wear, corrosion and erosion measurements emerged. Appropriate irradiation facilities were elaborated for activation of different parts of different forms and sizes as well as simple pieces of equipment (grinding machine, Microtom, etching desk, etc.) were installed to monitor the wear of the activated parts. During the cooperation real machine parts were activated and investigated in tribometers or test benches. By broadening the range of the materials and samples to be investigated it turned out that the nuclear data, especially the cross-section and yield data for nuclear reactions necessary to estimate the produced activities are poor in some cases, that's why we launched a nuclear data measurement and compilation program to establish a database for these reactions in cooperation with the IAEA. The materials, which cannot be activated directly were labelled using the secondary recoil activation. The international transport regulations and cooperation partners without license for using radioactive materials in their premises motivated us to elaborate the Thin Layer Activation (TLA) method by using activities under the Free Handling Limit (FHL).
The irradiations/activations are performed on a dedicated beam line of our cyclotron laboratory mainly with proton or deuteron activation. The bombarding energy is set to a value so that the activity distribution of the main radioisotope produced is constant up to a given depth of the surface (homogeneous activation). If it is not possible the distribution is set to linear. Single or multiple spots, larger areas are activated into a depth required by the particular task. The depth can be adjusted by altering the irradiation angle. A particular task may require the presence of different radioisotopes in the same sample or in two samples with friction contact. In this case a non-interfering pair of isotopes are chosen. The first measurements are performed by using high resolution gamma-spectrometers in order to assess all isotopes and their activities, the real wear (corrosion or erosion) measurement can be performed by high efficiency detectors (e.g. scintillation crystal) with discrimination to a given radiation of the chosen isotope.
During more than 20 years'experience in Thin Layer Activation we could successfully use both the high activity method and the FHL activations in solving real wear measurement tasks, as well as developed the production of a series of radioisotopes applicable for wear measurements. Our results also extend to the nuclear data measurements, where much more radioisotopes are measured and discussed from the point of view of TLA.

Country/Organization invited to participate

Hungary

Primary author: Mr DITRÓI, Ferenc (Institute for Nuclear Research, Hungarian Academy of Sciences, Hungary)

Co-author: Mr TAKÁCS, Sándor (Institute for Nuclear Research, Hungarian Academy of Sciences, Hungary)

Presenter: Mr DITRÓI, Ferenc (Institute for Nuclear Research, Hungarian Academy of Sciences, Hungary)

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