Project title: AMS nanotechnology applied for the Investigation of Tritium mobility and absorption in materials used in detritiation plants of heavy water from nuclear power plants, with the final aim of environment and life protection.

Stage III

Study of behavior hydrogen isotopes in different properties of tritiated water or tritium gas: concentrations, temperature, contact time and pressure

Final date: 15.12.2010

Partners: ICSI-Rm. Valcea, INCDFM and UPB

Expected results are: scientific report, model experiments.

The project objective is to study the behavior of tritium and deuterium in different materials such as various types of steels, metals like: Ti, Zn, V, Pd (Cu, Al) and in "glassy carbon" by the Accelerator Mass Spectrometry (AMS), a very sensitive method, capable to distinguish very small quantities of tritium and deuterium in solid samples reaching to distingue 10^6 of tritium atoms/cm^2 on sample and using very small amount of the sample to study.

Determination of very small amounts of tritium and deuterium (under the limits of detection of the usual methods of measurement) allows the rapid (2 years) characterization of evolution, over 10 – 15 years, of the features of the materials used in storing and circulating of the tritium gas and of the HTO in the detritiation facility.

The project Task implies several stages of execution. The required beam time is for the stage III

The quantity of Tritium will be determined in these materials by scintillation and by AMS method. By means of AMS will be determined the final concentration from the sample and the depth profilometry. The AMS method will be used for extremely small quantities of tritium for not being "contamination" the AMS installation. The two methods are complementary. The comparison of the results obtained by the two different methods will be done for concentrations at the inferior limit of analysis of the scintillation method. In the case when this allowed limit is passed over according to AMS conditions, the AMS samples will be controlled in their dilution by adding silver powder or carbon, but only in the case of the samples that are powder.

Taking into account the reduction of the penetration depth of the Tritium as well as the finding of adequate materials to deposit the Tritium, the same materials used above will be treated in various ways. The steels will be covered to the surface with thin layers of different metals (Cu, Ni) or with pellicles of polymers. The materials treated this way will be analyzed.

There will be realized a study by which will be distinguish the improved features by the appliance of the treatments and it will also be realized a study concerning the types of materials that are adequate for the storage of the tritium and how the applied treatments act on the storing qualities.

Analysis will be performed on carbon plates, Titanium plates, Palladium plates Niobium plates and 2 types of Tritium marked steel produced by ICSI Rm. Valcea

(tritiation with TH0 of very low concentration 34Bq/l). Concentration Depth profiling up to 5-6 microns will be determinate.

To be studied the penetration in time of the tritium will be realized the depth profilometry of the tritium concentration in different times from the depositing of the samples. The profilometry will be determined in the untreated metallic foils after a half year from their tritiation.

Beam Time Request

We ask for 5 days of beam-time in the period 1.10-5.10.2010
The experiment will use the 7.5 MV value of the terminal voltage to determine tritium concentration and several sequences of short time (10 min.) will use the 8 MV value of the terminal voltage for pilot beam.

Required beam time extent explanation.

Conditioning and starting the AMS Sputter Source: ca. 20 hours.

We will measure 10 sample as plates Ti covered with thin layers of different metals (Cu, Ni) or with pellicles of polymers.

We will measure again the 8 samples as powders which were measured in the last beam time in order to observe time evolution of the tritium concentration in these ones.

To introduce this sample in a new sample cartridge it is necessary to cool the AMS ionizer and then it must to start again the source. For these operations it is absolute necessary 16 hours.

Every sample measurement must be made between two measurements of the standard sample. The results of these two measurements will be averaged.

After every set of measurements the blank sample will be measured in order to verify the degree of an eventually contamination from the previous measurements. Blank samples will be also used to determine the sensitivity limit. For AMS analyze the experimental time is practically doubled by these calibration measurements.

- **Any other observations sustaining its approval by the PAC.**

The tritium concentration of the samples and standards are below the exemption limits and exposure of personnel and plant contamination are below the exclusion limits provided in the basic safety radiological rules (Legea111/96).

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