



PL9601114

# DEPARTMENT OF NUCLEAR PHYSICAL CHEMISTRY

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## PERSONNEL

### Laboratory of Nuclear Physical Chemistry

#### *Research staff*

Jan Mikulski, Professor,  
Barbara Petelenz, Ph.D., Head of Laboratory  
Ewa Ochab, Ph.D., Deputy Head of Laboratory,  
General Inspector of the Occupational Health and Safety,  
Paweł Zagrodzki, Chem.E., M.Sc.

#### *Technical staff*

Paweł Grychowski, M.Sc.  
Ryszard Misiak, M.Sc.  
Mirosław Szałkowski, Chem.E., M.Sc.  
Bogdan Wąs, Chem.E., M.Sc.

### Laboratory of Chemistry and Radiochemistry

#### *Research staff*

Zdzisław Szegłowski, Assoc.Prof., Head of Laboratory  
Barbara Kubica, Ph.D., Deputy Head of Laboratory

#### *Technical staff*

Maria Tuteja-Krysa, M.Sc.  
Roman Fiałkowski

### Environmental Radioactivity Laboratory

#### *Research staff*

Mirosława Jasińska, M.Sc., Head of Laboratory  
Krzysztof Kozak, Nucl.E., M.Sc.  
Piotr Macharski, M.Sc.  
Jerzy Wojciech Mietelski, M.Sc.

## GRANTS

The following grants have been received from the State Committee for Scientific Research (KBN):

1. Head: Professor Jan Mikulski.

Research Grant no. 202599101 *Neutron - deficient isotopes for medicine. Optimization of radiometric and analytical methods.*

2. Head: dr habil. Zdzisław Szegłowski;

Research Grant no. 226129102 *Studies on the chemical properties of transactinium elements ( $Z > 104$ ) in aqueous solutions in model systems with their homologues (Zr, Hf, Nb, Ta, W).*

3. Two investment grants (INP symbols: A02 and A09) for the upgrading of the gamma spectrometric measurements, 1993.

## OVERVIEW:

The Department consists of three laboratories working on various projects of pure and applied nuclear, analytical and physical chemistry.

### Laboratory of Physical Chemistry of Separation Processes

The main interest of this research group is the production and separation of neutron-deficient isotopes for medical diagnosis (SPECT). Recently, the main interest was in  $^{111}\text{In}$  which is a promising tracer for cancer diagnosis. To increase the effectiveness of production of indium  $^{111}\text{In}$ , the reaction with deuterons on the enriched cadmium target was carried out instead of the previously used one with alpha particles on natural silver. The change of in the way of production required switching from thermal separation of the radioactivity to the extraction method.

The separation processes were controlled by means of gamma spectrometry. Owing to the investment and research grants from KBN, the measurement equipment has been recently upgraded by purchasing two HPGe detectors from the detector laboratory of the Institute and two gamma spectrometry tracts from SILENA.

Non-radioactive contaminants in the samples were detected by means of atomic absorption spectroscopy (AAS). The AAS laboratory is also involved in programs to determine of trace elements in environmental and biological samples. The main cooperation in this respect has been with the Environmental Radioactivity Laboratory of this Department, with the Medical School of the Jagellonian University and with the Institute of Nuclear Research in Řež (Czech Republic).

Another project in the group is the preparation of thin layers using the Langmuir-Blodgett method. The method turned out excellent for the preparation of sources for alpha and electron spectroscopy.

Finally, a project on the sulphide-sulphite method of flue gases desulphurization was also carried out in the Laboratory.

### Laboratory of Chemistry and Radiochemistry

The studies of physicochemical properties of transactinide elements 104, 105 and 106 in model systems with their homologues Hf, Ta (Pa) and W were continued in collaboration with the JINR in Dubna as well as the IPN Orsay, and were partially supported by the Polish State Committee for Scientific Research (Grant No. 226129102). In the scientific program investigations have been carried out on the following subjects:



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1. Rapid methods of isolation of the short-lived ( $>5$  sec) isotopes of Hf, Ta and W from the nuclear reaction products obtained in the targets bombarded by heavy ions from the U-400 Cyclotron of JINR Dubna.
2. Studies of Hf sorption on ion exchange resins from acetic acid media as well as from mixtures of acetic and nitric acid.
3. A method for deep decontamination of the  $^{178m2}\text{Hf}$  isomer from microquantities of Sc, Te, Co, Ni, Sb and Ag.

## Environmental Radioactivity Laboratory

As a part of the National Network for the Early Warning of Radioactive Contamination in the Air, the Laboratory conducts continuous monitoring of radioactive contamination of the atmosphere at ground level, using a field station ASS-500 situated at the premises of the Institute. Weekly reports are submitted to the National Atomic Agency (PAA) and to the Central Laboratory for Radiation Protection (CLOR).

The Laboratory is also involved in the research programme on radioactive contamination in forests. During 1993 nearly 300 samples of mushrooms (34 species), plant (blueberry) and two layers of forest litter, collected in the autumn of 1991 from all over Poland, were analysed with the low-background HPGe gamma-spectrometer. This work was carried out as the continuation of investigations which were started in 1991. Altogether 800 samples were analysed. Besides the gamma-spectrometric measurements, in 1993, several alpha-spectrometric measurements of the activity of plutonium isotopes in forest litter samples were carried out. For this purpose a radiochemical procedure for plutonium determination was developed and tested.

In collaboration with the Institute of Geography of the Jagellonian University, studies on local (vertical and spacial) variation of radiocaesium content in various kinds of soil were carried out for various landforms.

Prof. J. Mikulski

## REPORTS ON RESEARCH:

### Langmuir-Blodgett Films Used for Mono-Molecular Alpha-Spectroscopic Source Preparation

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B. Wąs

A modified Langmuir-Blodgett technique which had been developed previously<sup>1</sup> for the preparation of mono-molecular sources for low-energy beta spectroscopy was applied to the preparation of  $^{241}\text{Am}$  source for alpha-spectroscopy. High efficiency of the americium ions sorption has been achieved. The obtained energetic resolution was limited by the alpha spectrometer but it seems to be better than 30 keV. A further investigation with other alpha-emitters will be performed next year. The improvement of the spectrometer resolution is planned, and the actual value for the FWHM will be determined. The method seems of great promise.

<sup>1</sup>B. Wąs, *Nucl. Instrum. Meth. Phys. Research A332* (1993) 334-331.