



Contribution ID: 213

Type: Poster

## Recovery and isolation of hafnium isomers from $^{176}\text{Yb}$ target irradiated by $^4\text{He}$ ions in optimized conditions

*Tuesday, 20 April 2010 11:45 (20 minutes)*

Interest to high-spin ( $16+$ ) long-lived (31 y)  $^{178\text{m2}}\text{Hf}$  isomer was established since 20 years ago because of a possibility to produce it in a micro-weight amount for consecutive studies of nuclear reactions with high-spin target and for potential application as an energy accumulator. Production of  $^{178\text{m2}}\text{Hf}$  was described in [1] via spallation of Ta by protons at LAMP facility and via  $^{176}\text{Yb}(^4\text{He}, 2n)$  reaction at Dubna cyclotron [2]. Series of experiments with the  $^{178\text{m2}}\text{Hf}$  target had been carried out due to cooperation of FLNR with European research centers and the results were summarized in [3] and refs. therein. On today, the innovative perspectives for creation of tiny energy sources support the continuing interest to  $^{178\text{m2}}\text{Hf}$ .

In the present report, we describe an optimized production of  $^{178\text{m2}}\text{Hf}$  using the  $^{176}\text{Yb}$  target of special construction irradiated at internal beam of the U-200 cyclotron in Dubna. The 96% enriched  $^{176}\text{Yb}$  oxide was deposited onto water-cooled Al backing, and the target surface was inclined to the beam at angle near 10 degrees. The target thickness of 7 mg/cm<sup>2</sup> has provided effective thickness in a beam direction of about 80 mg/cm<sup>2</sup> in ligature weight. The  $^4\text{He}+1$  ions reach an energy of 35 MeV. With beam intensity limited to be lower 15 microA, the corresponding beam power does not exceed 500 W. Such conditions were safe, but the target could stand even at 3 times higher beam intensity. After irradiation the target material  $\text{Yb}_2\text{O}_3$  was washed off from the backing with 16 M  $\text{HNO}_3$  and anion exchange in conc. HCl solution was applied to separate Hf-fraction. With the same purpose precipitation of  $\text{YbF}_3$  was also tested [4]. Deep purification was carried out using the anion exchange chromatography in HF solutions with an overall chemical yield upon the average 85%. Activity of the irradiation products was controlled by the gamma-spectroscopy method using HPGe spectrometer. All gamma-lines belonged to  $^{178\text{m2}}\text{Hf}$  and  $^{179\text{m2}}\text{Hf}$  were quantitatively measured and absolute yields of both high-spin isomers were determined with appropriate accuracy.

Under described conditions several  $^{176}\text{Yb}$  targets were irradiated, and, in total,  $6 \times 10^{14}$  atoms of  $^{178\text{m2}}\text{Hf}$  were produced over beam time of 900 hours. The isomer cross-section and impurities content obtained in the present experiments are in a good agreement with the data published earlier [2]. Change to the internal beam at the cyclotron and more tangential beam-to-target geometry supply higher yield of the products and make the production method more economic. The position of a target inside the cyclotron camera leads to the decreased neutron flux outside and meets the requirements of modern radiation safety rules. Improving the biological shielding at the accelerator and increasing the beam current, one can expect a productivity of about  $3 \times 10^{15}$  of the  $^{178\text{m2}}\text{Hf}$  isomeric material per 1000 hours of effective irradiations.

1. W.A. Taylor, J.G. Garcia, V.T. Hamilton, et al., J. Radioanal. Nucl. Chem., 236, 155 (1998).
2. Y.T. Oganessian, S.A. Karamian, Y.P. Gangrski, et al., J. Phys. , G, 18, 393 (1992).
3. S.A. Karamian, Acta Phys. Pol. B, 26, 375 (1995).
4. N. V. Aksenov et al., contribution to this conference.

**Primary authors:** Dr BOZHIKOV, Gospodin (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research); Mr AKSENOV, Nikolay (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research)

**Co-authors:** Mr STARODUB, Genadi (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research); Mr VOSTOKIN, Grigoriy (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research); Dr KARAMIAN, Sarkis (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research); Prof. DMITRIEV, Sergey (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research); Mr ALBIN, Yuri (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research)

**Presenters:** Dr BOZHIKOV, Gospodin (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research); Mr AKSENOV, Nikolay (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research)

**Session Classification:** Poster Session - Production and Application of Radionuclides

**Track Classification:** Production and Application of Radionuclides