Preparation of a (-ray Calibration Source of ^{180m}Hf

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We have used the decay of ^{180m}Hf ($t_{1/2}$ = 5.5h) to obtain a very precise (-ray calibration source in the 90 to 330 keV energy range. The decay of ^{180m}Hf to the ^{180}Hf ground state includes a cascade of three consecutive E2 (-ray transitions of energies 93.3, 215.2 and 332.3 keV with no other feeding of the intermediate states. Since the total transition intensities must be the same, the relative (-ray intensities emitted by the source are thus dependent only on the calculated E2 conversion coefficients. This provides a uniquely well-known calibration standard.

We produced the isotopes of ^{180m}Hf by irradiating a 0.91 mg sample of HfO_2, isotopically enriched to 87% in ^{179}Hf, at the TRIGA reactor in the TAMU Nuclear Science Center. The thermal neutron cross section for ^{179}Hf (n, () ^{180m}Hf is 0.4 b. Irradiation in a neutron flux of $N = 7 \times 10^{12}$ neutrons / cm^2 /s for 26 minutes produced 10 :Ci of activity, principally ^{180}Hf ^{m}.

In order to minimize the self-absorption of (-rays in Hf we required a thin source. Following a procedure described by Kellog & Norman [1,2], the activated HfO_2 sample was dissolved in 0.50 ml of hot 48% HF acid. The solution was stirred for 20 minutes while being maintained at 70-80°C. The HfO_2 reacted with the HF to produce HfF_4, which remained in solution. A 0.03-0.04 ml drop of the solution was then deposited on a 50 :g /cm^2 carbon foil, which

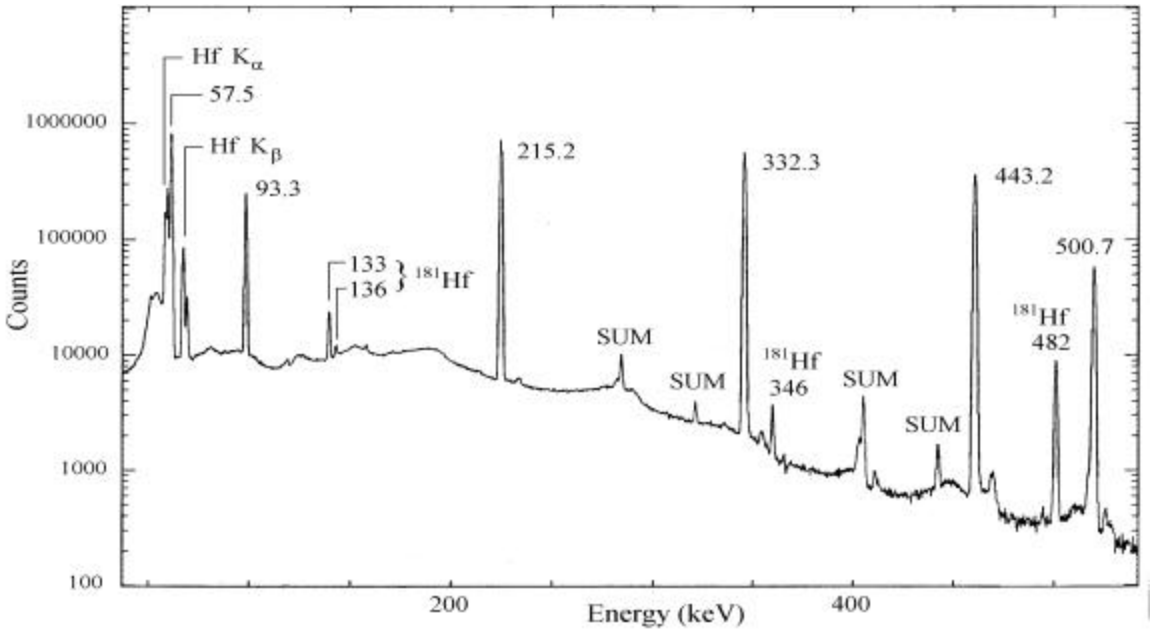

Figure 1: Gamma-ray spectrum of ^{180m}Hf recorded with a 70% HPGe detector at 15 cm for 4.2 h. The ^{180m}Hf peaks are labeled with their energy only or with "sum". Peaks from 42-day ^{181}Hf are also indicated.

had been pre-mounted on 75-:m-thick Mylar foil backing and coated with insulin. For about 20 minutes the HF acid was evaporated under gentle heat, leaving the HfF_4 salt residue stuck to the carbon foil in small thin clumps (< 5 :m thick). Finally, we placed another 75-:m Mylar foil on top of the source, sealing it with tape at the edges.

The (-ray spectrum recorded with our 70% Ge detector is shown in Fig. 1. In the energy region of interest, only quite weak "contaminant" peaks, from ^{181}Hf, are seen. They are well removed from the ^{180m}Hf cascade (-rays and cause no problems. Analysis of the data is in progress.

References

1. S.E. Kellog and E. B. Norman, Phys. Rev. **C31**, 1505 (1985).
2. S.E. Kellog and E. B. Norman, Phys. Rev. **C46**, 1115 (1992).