Study of odd Osmium isotopes from EC decay

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Introduction

The structure of odd-mass nuclei in the region of Os-Pt isotopes are of great interest from nuclear structure point of view, but difficult to produce by in-beam method. Though reasonable amount of spectroscopic information is available for the even-even nuclei in this heavy transitional region, information on the odd isotopes of Os are very few [1, 2]. In most of the cases, data from only decay studies and light ion transfer reactions are available [3]. With the availability of high resolution HPGe detectors, more complete information on the low lying states of the odd mass nuclei in this region are possible to obtain. The low lying excited states of odd-mass nuclei in this region indicates that established phenomenological model may not work very well and coupling of single particle excitations to low energy vibrational modes of the even-even core is important to consider [4]. The aim is to obtain complete spectroscopic information on the excited states of Os isotopes, specially the odd ones, from the measurement of feeding intensity, branching ratios, lifetime and quadrupole moment. As a part of the above experimental studies, an offline measurement of the feeding and energy of the excited levels of Os isotopes produced from the electron capture decay of Ir isotopes is reported in the present work.

Experimental Details

Excited states of Os isotopes of A=186-189 region were populated via the EC feeding of Ir isotopes, produced by irradiating a natural Re foil with the alpha beam of Variable Energy Cyclotron at Kolkata. The 40 MeV alpha beam was degraded to 32 MeV and the Ir isotopes produced through fusion evaporation channels were stopped in an Aluminium catcher foil placed at the back of Re target. The natural Re foil has an isotopic abundance of 37.4% and 62.6% of ^{185}Re and ^{187}Re respectively. At the above mentioned energy of incident alpha beam, mainly $^{186-189}$Ir isotopes were produced (2n and 3n evaporation channels), which decays via electron capture and populate the excited states of Os isotopes. As most of the decay gamma rays of interest are of low energy, those were counted with a planer segmented Ge LEPS detector with each pixel active area of 7cm^2 and a thin entrance window of 300 micron Be. The activities were also counted with an HPGe detector to identify the higher energy gamma rays beyond 400 keV. The detectors were calibrated with standard radioactive sources including the 6-7 keV X-ray and 14.4 keV gamma ray of ^{57}Co source for lower energy part.

Results and Discussion

The added gamma spectrum of four segments of LEPS detector, obtained after irradiation is shown in Fig.1. Various low energy transitions as due to the decay of Ir isotopes are identified. The 25 keV transition de-exciting the state at 100.45 keV in ^{187}Os is of interest. This 7/2$^-$ state has been identified as the 7/2$^-$[503] Nilsson state. Measurement of quadrupole moment of this state by TDPAD method has been planned. As the lifetime of the state is 112 ns, the timing correlation can be obtained using planer Ge LEPS and coaxial HPGe detectors. Though 25 keV has a small contribution from ^{189}Os also, but as the half-life of ^{18}9Ir decaying to ^{189}Os is 13.2 days and the feeding intensity of 25 keV in ^{189}Os is about two order of magnitude less compared to that in ^{187}Os ($t_{1/2}$ = 10.5 hr), it will not have much overlap with the 25 keV transition decay in ^{187}Os. Moreover, by gating on the feeding transitions to the 100.45 keV in coaxial HPGe detector, the 25 keV transition of ^{187}Os can be selected. Fig.2 shows part of the spectra taken with LEPS detector with different time interval after irradiation. Out of the produced nuclei, ^{186}Ir and ^{187}Ir have shorter half lives of 16.64 hr and 10.5 hr respectively, whereas, the other two isotopes of ^{188}Ir and ^{189}Ir have relatively longer half lives of 41.5 hr and 13.2 days respectively. Thus at beginning of offline counting ^{186,187}Ir dominated the gamma ray spectra and the decay of ^{188,189}Ir isotopes was followed later.

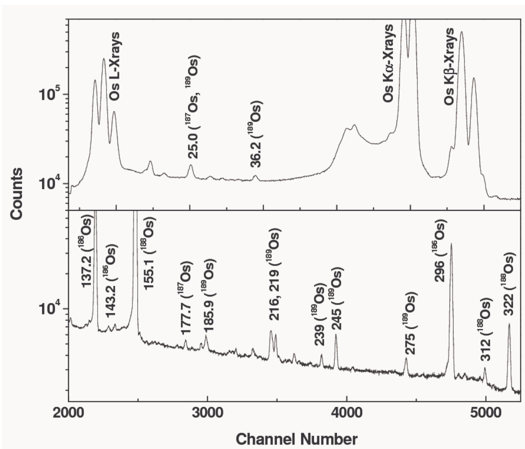

Fig. 1: Gamma ray spectrum obtained with planer Ge (LEPS) detector. Identification of transitions from respective product is shown.

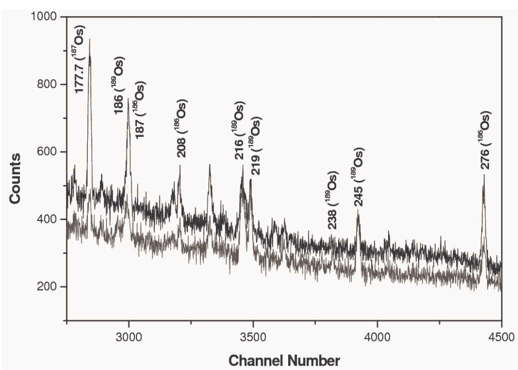

Fig. 2: Gamma ray spectra obtained with planer Ge (LEPS) detector after 18hr (black) and 51hr (red) of irradiation.

The higher energy part of the spectrum observed with HPGe detector after 48 hr of irradiation is shown in Fig.3. As the half-life of ^{188}Os is 41.5hr, the stronger gamma transitions observed in this spectrum are mainly from ^{188}Os. Some of the gamma transitions of ^{189}Os ($t_{1/2}$ = 13.2 days) are also observed.

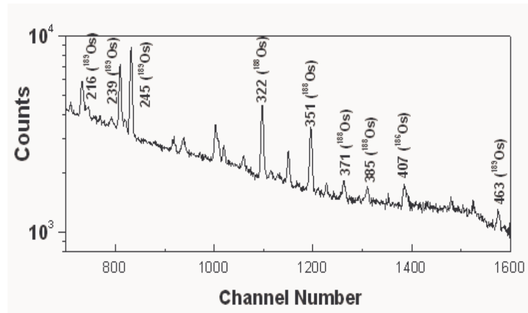

Fig. 3: The higher energy part of the decay spectrum observed with coaxial HpGe detector.

Summary

In summary, measurement of gamma transitions from the EC decay of Ir isotopes produced using alpha beam irradiation at cyclotron facility of VECC, Kolkata. The detail analysis of the decay feeding and transition intensities is in progress.

Acknowledgement

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References

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