Alpha particle induced cross section measurements on natural and enriched Cd at 50 MeV

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In year 2015 two series of measurements have been performed in January and December at the AVF cyclotron of RIKEN Nishina Center in the frame of a bilateral agreement between the Hungarian Academy of Sciences and the Japan Society for the Promotion of Science. One of those series was the investigation of alpha particle induced cross sections on ^{nat}Cd and enriched ^{116}Cd targets. The energy of the alpha beam was calibrated by using Time of Flight (TOF) methods before the December experiments. The results of this was also used to correct the results of the January experiments, because it turned out that the nominal 50 MeV alpha energy provided by the accelerator actually corresponds to 51.2 MeV energy. The enriched cadmium was deposited on Cu backing while the natural cadmium foils were pure metal foils from Goodfellow. In both irradiations we used thin Ti foils for monitoring the beam parameters, while in the enriched cadmium experiments also the Cu backing served as monitor.

The radioisotope ^{117m}Sn with 13.6 d half-life, which has already been used as a bone cancer pain relief agent, turned to be more important in medical applications. ^{117m}Sn has several advantages in modern cancer therapy. It has conversion electron radiation with an average energy of 140 keV allowing about 300 μm effective treatment range, the half-life is convenient for production, labelling and delivery within several hundreds of kilometers, its 159 keV gamma line is also convenient for using the commercial imaging techniques e.g. gamma camera. Taking into account all these properties ^{117m}Sn is a unique candidate between all potential medical isotopes[1].

The first stack was assembled from enriched ^{116}Cd deposited on 12 μm Cu backing. The average thickness of the Cd layer was measured as 21.9 μm. For further monitoring several Ti foils with nominal thickness of 12 μm were also inserted between the Cd targets.

The alpha induced cross sections on both natural and enriched ^{116}Cd and ^{nat}Cd targets have already measured by several authors[2,3,4], the purpose of the present study was to resolve the big discrepancies of the different results and to extend the energy range of the measurements (see Figs. 1 and 2). The preliminary results are shown in Fig.1 for the enriched targets and in Fig. 2 for natural cadmium, both for the medically important ^{117m}Sn radioisotope. On Fig. 1 our results are much higher than the others under 30 MeV, that is why we have measured the spectra in the December experiment much longer, in order to separate the contribution from other isotopes. At list one of the previous results on natural cadmium is obviously wrong (Fig. 2), so our contribution may give the correct results, as the it is confirmed by the shape and amplitude of the TENDL prediction.

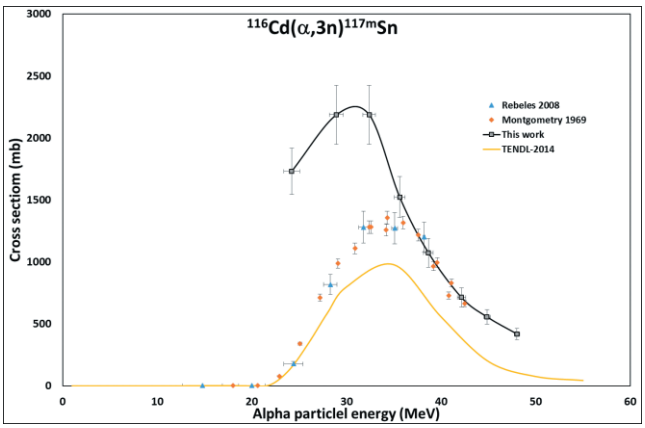

Figure 1. Preliminary result of cross sections for the ^{116}Cd(α,3n)^{117m}Sn reaction

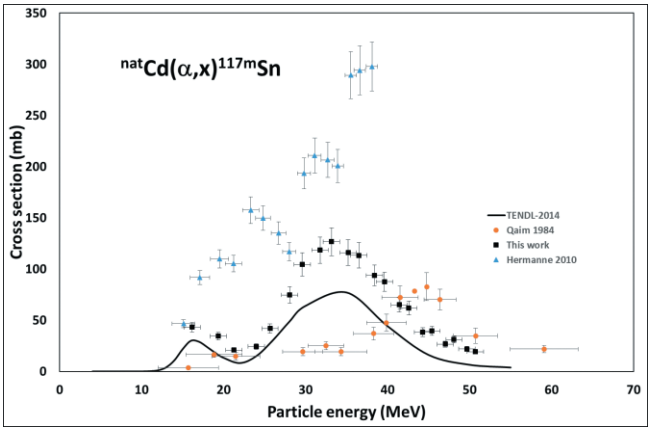

Figure 2. Preliminary result of cross sections for the ^{nat}Cd(α,3n)^{117m}Sn reaction

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