Nuclear Reaction Cross Section Measurements Via Characterisation Of Soft Radiation Emitting Products

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Nuclear reaction cross section measurements via the activation technique are generally done using high-resolution γ-ray spectrometry. However, in cases where the radioactive product decays exclusively by EC (without emitting a γ-ray) resort has to be made to the rather subtle technique of X-ray spectrometry. Similarly for characterisation of pure β^- emitters, gas flow proportional or liquid scintillation counting is applied. For both X-ray spectrometry and gas flow proportional counting thin solid samples are needed. For liquid scintillation counting, on the other hand, the disturbing organic and inorganic material has to be absent. Thus the use of radiochemical methods is most essential.

We studied the ^{nat}Ti(p,xn)^{49}V ($T_{1/2}$ = 330 d) and ^{85}Rb(p,xn)^{82}Sr ($T_{1/2}$ = 25.5 d) reactions from their respective thresholds up to 70 MeV via X-ray spectrometry. In each case a very clean radiochemical separation was performed and a thin source was prepared. The radioactivity of ^{49}V was determined using the soft 4.5 keV k_α X-rays and that of ^{82}Sr via the 13.4 keV k_α X-rays. In another study, the reactions ^{nat}Ti(p,x)^{45}Ca ($T_{1/2}$ = 163 d), ^{89}Y(n,p)^{89}Sr ($T_{1/2}$ = 50.5 d) and ^{nat}Pb(p,x)^{204}Tl ($T_{1/2}$ = 3.78 a) were investigated. All the products are pure β^- emitters and therefore clean radiochemical separations were mandatory. The radioactivity of ^{45}Ca was determined by liquid scintillation counting and those of ^{89}Sr and ^{204}Tl via low-level anticoincidence β^- counting.

In the presentation, the difficulties, pitfalls but also the advantages of the interdisciplinary techniques used will be discussed. The cross section data for ^{82}Sr and ^{89}Sr are of medical interest, those for ^{45}Ca, ^{49}V and ^{204}Tl are of value for estimating the activation of irradiated materials.

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