Homogeneity and thickness measurement of large-area targets for the (n, cp) reaction cross section studied at n_TOF CERN

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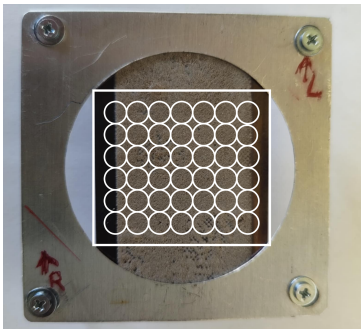
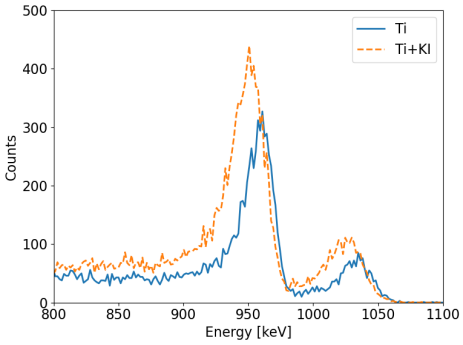
In preparation for neutron-induced reaction cross section measurements of the ^{39}K(n, cp) channel at the n_TOF facility [1], the thickness and homogeneity of a potassium iodide (KI) target were evaluated using a ^{207}Bi electron source. ^{39}K is a component of sodium-potassium (NaK) alloys, which are proposed as coolants in experimental fast neutron nuclear reactors [2,3]. Accurate cross section data for ^{39}K(n, cp) reactions are therefore crucial for reactor design and safety analyses in these advanced systems. The KI sample was produced at the department of chemistry, TRIGA site, Johannes-Gutenberg University Mainz. KI was deposited on a 25 µm thick titanium (Ti) backing. The area of Ti foil is 4×7 cm^2, the deposition area is 3×6 cm^2. The material was printed by Drop-on-Demand printing technique [4], twice on the surface, in total about 15000 drops, 20 nL each were placed. It gives 166 mg of KI, which corresponds to a mass per area of 8.4 mg/cm^2 on average. The thickness of the Ti foil precluded the use of alpha particles due to their limited penetration range. Instead, collimated electrons from the ^{207}Bi EC source of 0.5 cm diameter were used to probe the target material using energy loss measurements. ^{207}Bi undergoes electron capture decay, forming an excited ^{207}Pb nucleus, which then emits internal conversion electrons (ICE). The most intense emitted electrons have an energy of 976 keV [5]. The energy loss of such an electron in a KI sample of thickness of a few mg/cm^2 is of a few keV [6], which is sufficient to be measured with a silicon detector. The thickness was probed at 42 points on the target, as can be seen in Fig. 1a. An example energy loss comparison between a titanium-only sample and one with KI can be seen in Fig. 1b.



(a)



(b)

FIG. 1: **(a)** Potassium iodide (KI) target on a titanium (Ti) backing placed in a bracket for stability. White circles represent the ^{207}Bi source positions at which the thickness was measured. **(b)** An example spectra for a Ti-only target and for KI on Ti.

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