Pb targets for Notre Dame report

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January 28, 2023

Abstract. This report has the porpuse of resume the work developed, in the last months, in order to produce self-supported thin lead (Pb) films, highly enriched in ^{208}Pb. To achive the self-supporting state of the final films, we start to evaporate the lead onto a formvar subtratrate, atatch the resulting thicker film into a frame and then clean the remaining formvar by dissolving it with chloroform. Several tests have been made to enhance the production process and the overall analysis is here presented. Characterization has been done using energy loss of alpha particles through the films with aditional AlfaMC simulations for severeal samples and also RBS with aditionl SIMNRA simulations. Results for the targets' thicknesses were extracted in agreement from the different characterizations and the cleaning method was proven to be sucssesfull reaching very low formvar contamination.

Looking at figure 1 we can see that the uncleaned target shows a deep step structure in the carbon and oxygen signal region, meaning that at this point there is a thick layer of formar in the film. After the first washing we can see that the stair pattern starts to vanish and the end of the curve begins to reach the background level, meaning a decrease in the layer thickness but, still, with an appreciable yield. After the second wash, the layer of remaining formvar is so thin that the peak structure appears within the regions of carbon and oxygen signals and there is a considerable reduction in the yield of these signals. After the third wash, the signals of the formvar contamination are almost indistinguishable from the background and about 2 orders of magnitude lower than the signal from the lead.

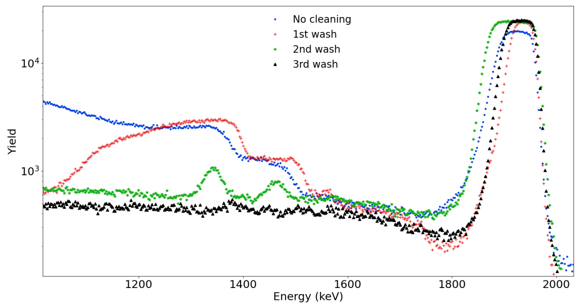

Figure 1. Visualization of the formvar contamination vanishing as the targets get cleaner.

We should remember that these spectrums come from four different targets, each one cleaned (or not) the way we present, and not the same target after each process. That's why the lead signals slightly vary from one to another.

Targets 1 and 2 show a larger FWHM than we were expecting regarding the thickness they should have based on the analysis of other targets produced in close conditions. This has to be confirmed with the analysis of alpha particles' energy loss through these targets. This effect suggests that there was an error in the alignment of the target ladder angle.

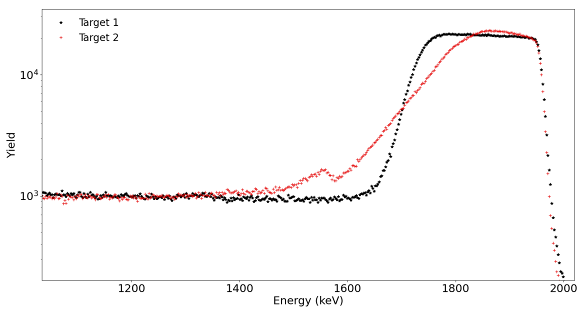

Figure 2. RBS1 spectra from targets 1 and 2.

Target E2 (from a previous evaporation) was analyzed at zero and 180°, which means the beam facing the surface where the formvar was first and the beam facing the lead surface, respectively. From figure 3 we can see that at 180° (beam facing the lead surface) there is a visible signal in the region of oxygen. This could be explained by another contamination channel, that appears when the films are kept for long time, which is a layer of oxidation in the surface of the lead film. (confirm if the oxidation layer always forms on the same side)

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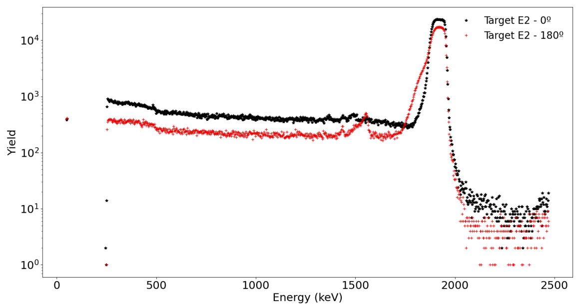

Figure 3. RBS1 spectra from target E2 at positions 0° and 1800°.

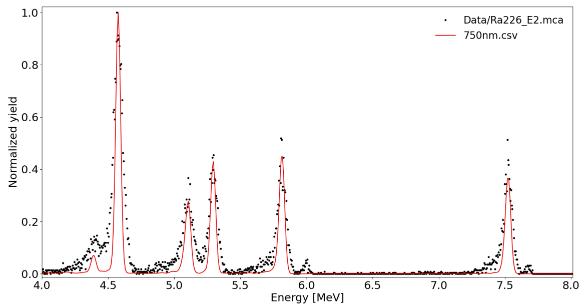

Figure 5. AlfaMC simulation over alpha particles' energy loss through target E2.

Looking at figures 2 and 3, namely the red spectrum of each (Target2 and Target E2 - 0°), we can see the same pattern for the signal of oxygen, and also a sloped step on the left side of the lead signal. This can also be the result of the roughness of the films, not at a microscale but at a macro scale. Because the 15 mm hole of the frames is too large, some films don't turn out properly stretched and this can result in significant differences in the angles involved as in the path traveled by the protons.

The thickness of target E2 was determined to be approx. 715 nm fitting SIMNRA simulation with RBS data, figure 4. This is in agreement with the previous 709 ± 18 nm determined via alpha particles' energy loss and fitted with the AlfaMC simulation of a 715 nm layer of lead, see figure 5.

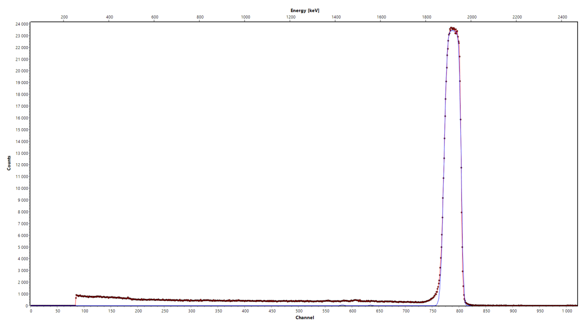

Figure 4. SIMNRA simulation over target E2 RBS spectrum.