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# Study and development of a new target system for the NUMEN experiment

In the NUMEN experiment [1], one of the most critical points to be addressed is the interaction of high intensity beams with the target with heat development that needs to be dissipated to avoid the fusion of low melting point isotopes. The target must also be thin to avoid degrading the energy resolution of the MAGNEX spectrometer, and its containment system must be limited in material to optimize the detection of gamma rays emitted in the interactions via the G-NUMEN calorimeter arranged around the interaction chamber. The proposed solution is to obtain the targets with the vapor-deposition technique of the isotopes to be studied on C-based substrates (HOPG or multilayer graphene) cooled to cryogenic temperature via a shaped copper target holder with the minimum of material to connect to a cryocooler. In order to optimize the choice of the most suitable substrate in NUMEN, different quantities are evaluated with different techniques. Alpha Particle Spectroscopy measures the thickness uniformity as well as Rutherford Backscattering Spectroscopy which adds information on the material purity. Moreover, a study of the heating of the substrates with infrared radiation provides interesting information for the comparison of the different materials under evaluation. The crystal order will be evaluated by X-ray diffractometry technique and Raman spectroscopy will evaluate the crystal order, while the surface will be analyzed using an electron microscope. Furthermore, the study of the behavior under irradiation of the substrate prototypes can help to understand the correlation that can exist between a variation of the thermal conductivity and the number of defects in the substrate lattice. Moreover, the deposition of elements with different physical and chemical properties requires a characterization to evaluate the adhesion to the different substrates, the degree of purity achievable, the uniformity of the thickness. Results obtained in the study of HOPG samples and different commercial multilayer graphene foils will be compared and discussed, and results of the first prototypes of targets obtained by evaporating natural elements on the multilayer graphene substrate will be presented.
[1] F. Cappuzzello et al., Eur. Phys. J. A (2018) 54: 72

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