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Design and test of an innovative static thin target for intense ion beams

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Current research in Nuclear physics often investigates rare reactions, which need intense beams to achieve a statistically sufficient amount of data. High beam intensities pose the problem of overheating the target, an issue, which becomes even more relevant when elements with low melting point are required. Currently, rotating targets are used, but such systems are cumbersome and complex. Moreover, the large ring-shaped target poses additive issues when target uniformity or cost cannot be neglected.

The proposed technique consists in the deposition of the target material on a substrate of pyrolytic graphite, whose superficial thermal conductivity is 2000 W/m/K. Heat is efficiently spread on the substrate, eliminating the need of a spinning support; this allows dissipating the heat via thermal contact with a cold sink instead of relying on thermal radiation.

Such target will be used in the NUMEN project, which uses targets of heavy isotopes and 18O and 20Ne beams with energy few tens of MeV/A, with intensity up to 60 uA. The target is few hundred nanometres thick and about 1 cm wide. The graphite substrate diameter is larger than that of the target and the exceeding part is pinched between two copper crowns at fixed cold temperature. The time evolution and the spatial distribution of the temperature have been numerically calculated. MatLab and Comsol programs have been used to evaluate the dependence of the maximum temperature on various parameters.

Concerning the deposition technique, the contact between target and substrate plays a major role in the heat transfer inside the system. In addition, the target homogeneity is a crucial requirement of the NUMEN experiment. In fact, the products of the nuclear reaction vary their energy by ionization and straggling, during the residual path inside the target and inhomogeneity in thickness affects the energy measurement. Therefore, the various deposition parameters have been carefully studied, to improve as much as possible the adhesion between target and substrate. Every deposited sample has been analysed by FESEM microscopy and a set of thickness measurements by proton back-scattering technique are planned in the next future, to test the thickness homogeneity of the deposition.

In the talk, the results of the calculations of the temperature distribution and of the thickness effects on the energy loss will be reported. The microscopy pictures of the deposition samples will be shown, together with the back-scattering measurements.

Selected session

Accelerators and Instrumentation
Nuclear Structure, Spectroscopy, and Dynamics

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