NEW APPLICATIONS OF LARGE AREA SELF SUPPORTING, ULTRA-THIN MULTI-LAYER AND CARBON FOILS

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For experiments at GSI and CERN we developed very large, self-supporting, ultra thin carbon foils that can also be used as a backing for additional multi layer systems at a yet unrivaled scale. The technique presented here isn't new and has been introduced already in 2002 *[1]*, but the wide spread utilization of additional support materials like Polyvinylalkohol for the production of ultra thin large area carbon foils suggests that its full potential hasn't yet been fully realized.

The carbon foils are produced in the E12 Target Lab by vapor deposition either from a laser plasma source or from electron beam heating *[2]*. Due to the application of a macroscopically rough substrate surface upon which the carbon layer is deposited, the unavoidable intrinsic tension of the deposited layer could be drastically reduced and, since the surface of the substrate is matched by the carbon foil after its release from the substrate, to a certain amount it even becomes quasi-elastic. This special property allows the carbon foils to withstand much higher physical stress, a highly increased dose of particle irradiation and eventually to carry a higher load (e.g. additional layers for a large area multi-layer target).

The choice of suitable substrates is limited beyond the surface they provide for the carbon layer also by the production procedure itself. To "pull away" the carbon layer from the substrate usually water is used as it has just the right amount of surface tension to keep the carbon foil afloat whilst the rest of the substrate is submerged. For the production of large area, self- supporting, ultra-thin carbon foils we employ a betain-saccharose based release agent because it is easily dissolved in water and additionally it forms a macroscopically (in the order of 10 µm) rough surface after its crystallization on e.g. a glass slide.

Using this method we were able to produce self-supporting carbon foils with a diameter of 80mm and a thickness of only 70nm for the ASACUSA collaboration at CERN. Subsequently these foils were used as a backing to support additional Ti/Pd (or Ti/Pt) layers that were employed as targets for antiproton in-flight annihilation by the same collaboration. A comparably large diameter of 80mm was necessary in this case to minimize antiproton annihilations on the frame while at the same time the target thickness was limited by the signal to background ratio *[3]*.

For the secondary electron TOF detector at the FRS-ESR we could even reduce the thickness of the carbon foils down to 45nm. Up to now this detector was equipped with 40mm carbon foils as secondary electron emitters but the acceptance of this setup could be significantly improved by increasing the foil diameter to 80mm. This allows for more revolutions of the ions under investigation before the unavoidable energy loss stops any further recirculation. Reducing the mass layer of the carbon foils while increasing their size triggered a large gain in performance for this detectors.

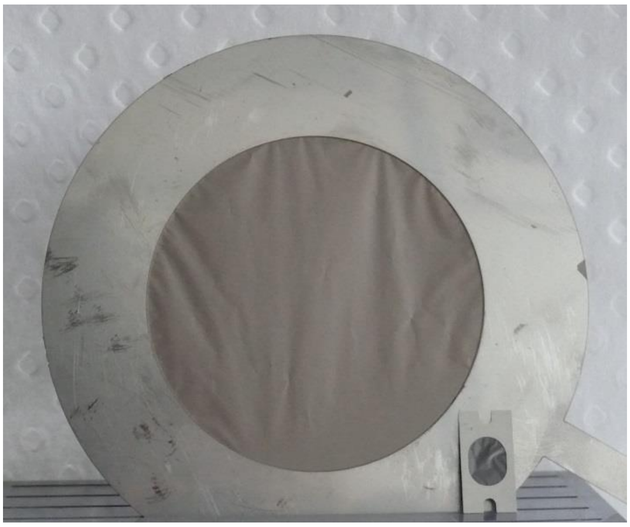

Figure 1: 80mm ultra-thin carbon foil for the ASACUSA experiment at CERN. On the bottom right a standard 90mm² frame as used at the MLL experiments is shown.

Similarly large foils have been produced for a tilted-foils nuclear-spin polarization experiment at the REX-ISOLDE linear accelerator, CERN. A beam of ^{8}Li with an energy of 200 keV/u traversed through a stack of 10 ultra-thin diamond-like carbon foils to polarize the nuclear spin. The attained nuclear spin polarization of 3.6 ± 0:3% was measured [4].

The availability of this new technology of large area thin foils induced lots of different ideas to improve and invent modern experiments.

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