Technological Laboratory of the TUM

P. Maier-Komor, M. K. Nacke, and W. Heimkes

1. Gadolinium-Carbon Targets for g-Factor Measurements with the Transient Magnetic Fields Technique[1]

For tandem experiments [1,2] multi layer targets had to be developed, consisting of 0.5 - 0.7 mg/cm^2 natural C; 3.6 - 3.8 mg/cm^2 Gd; 1 - 3 mg/cm^2 Ta; 2.0 - 2.5 mg/cm^2 Cu. The procedure to obtain ferromagnetic Gd layers was developed and improved in our lab in a five years period from 1988 on [3,4]. In the meantime we have even improved the ferromagnetic properties of Gd up to the theoretical value. This was achieved at a substrate temperature of 800 K as usual and heating and evaporating the Gd source material until the vacuum recovered to 2×10^{-5} Pa before the substrate shutter was opened. During Gd deposition the Ta backing was mounted between two standard stainless steel frames. After the last deposition of the Cu film the complete target was remounted between Al frames. This technique cannot be accomplished with the brittle carbon layer on the Gd, which would flake off. Therefore copper frames were applied, they have like Al no disturbing magnetic impurities but can stand the substrate temperature of 800 K. Unfortunately, carbon evaporated from an electron source does not adhere well to the Gd layer, even when a glow discharge surface-cleaning was applied. The carbon tends to flake off at a thickness close to 100 μg/cm^2. Therefore it was tried to solve this adherence problem by depositing 12 μg/cm^2 carbon from the laser plasma source at a power density of 8 GW/cm^2. The 1 μg/cm^2 mixing zone of Gd with C presents excellent adhesion. Before depositing the thermal evaporated carbon glow discharge is needed to remove the water film from the lpa-C. With this technique up to 700 μg/cm^2 C were deposited and sufficiently bonded to the Gd.

2. Carbon Stripper Foils from Laser Plasma Ablation Deposition, Investigations for Reproducibility and Simplification of the Technique[2]

Carbon stripper foils prepared by laser plasma ablation deposition are used with different thickness up to 10 μg/cm^2 on all stripper positions of the tandem. A poisoning by hydrocarbons of the UHV systems can be avoided since it was possible to increase the mechanical strength of these carbon stripper foils by a higher laser power density of 8 GW/cm^2 instead of the previously applied 2 GW/cm^2. Thus a collodion backing (source of hydrocarbons) was no longer necessary. The shape of the rotating substrate dome was designed for the deposition distribution at a laser power density of 2 GW/cm^2 where an overall thickness homogeneity of $\approx 3\,\%$ was measured. Within error bars of 10 % the thickness distribution should be the same for 8 GW/cm^2. To obtain a better accuracy in the thickness distribution and to adjust the calibration of the monitor quartz data for about 30 consecutive deposition charges were recorded. As anticipated the ablation lobe was slightly more peaked to smaller polar angles resulting in an underestimation of the carbon layer thickness with the monitor quartz by about 10 % and the average carbon thickness at a polar angle $\theta \approx 9\,^\circ$ is $\approx 9\,\%$ too thick in comparison to the thickness at substrate positions of wider polar angles. Fortunately, only 20 % of the effective substrate area is outside the uniformity of 3 %, which was obtained for all substrate positions at 2 GW/cm^2 power density. A new substrate dome is not needed to compensate the thickness inhomogeneity. Only the upper rim of the eight afflicted slide positions must be lifted by ≈ 18 mm, then the desired 3 % uniformity could be obtained again for the total area of the 20 double-size microscope slides which are carbon-coated in one charge. It is not always possible to float, mount and slacken the carbon stripper foils immediately after preparation. Therefore storage of the layers was performed in roughing vacuum. This storage method was now compared to storage in dry nitrogen. Slides from the same deposition charge were stored with both methods for a period of nearly eight months. The total mounting success rate was nearly 100 % for those slides stored in dry nitrogen compared to only 30 % for the ones stored in roughing vacuum. That is why storage in dry nitrogen or argon is now favored. For more details of this subject see ref. [5].

3. Investigation and First Preparation of VUV Reflective Coatings on Carbon Panels for the HADES RICH Mirror[3]

The in ref. [6] described UHV box coater was completed. Since the first depositions seemed to have a permanent water impurity, which lowers the reflectivity in the wavelength range from 160 to 170 nm, it was decided to evaporate MgF_2 from a Mathis SO-24 evaporator like it was done in the pilot plant instead from the installed electron beam source. For two reasons this electron source was used now for the evaporation of Ti. The Ti deposition improves the vacuum and the Ti layer on the substrate can be applied as diffusion barrier. The three sources are equipped with three independent shutters and shielded from each other by walls. The complicated shutter and shielding configuration was chosen to prevent cross-contamination. At a source to substrate distance of 87 cm, which is the radius of the mirror curvature, the spatial deposition distribution was measured for the rotating substrate with 500 mm diameter. For Al the maximum thickness inhomogeneity was 5 % from the center of the domed substrate to its rim. The thickness uniformity, however, is more important for the protective layer of MgF_2 where an inhomogeneity of $\approx 3\,\%$ could be realized. The reflectivity in the VUV wavelength range (140-210 nm) of the Al mirror layer had to be optimized by means of the thickness and deposition properties

[1]in cooperation with K. H. Speidel
[2]in cooperation with G. Dollinger and H. J. Körner
[3]in cooperation with G. Dollinger, R. Gernhäuser, J. Wieser, and A. Ulrich