VUV Optics for the HADES Project

W. Czech, J. Friese, R. Gernhäuser, P. Kienle, H. J. Körner, J. Labedzki, P. Maier-Komor, B. Russ, A.Ulrich, J. Wieser, S. Winkler, and K. Zeitelhack

Manufacturing and testing of optical components of the HADES-RICH [1] detector is described. In 1999 the large, 1.4m diameter, 5mm thick CaF_2 window, separating the C_4F_{10} radiatior gas from the CH_4 detector gas, has been completed and mounted in the detector housing. The window consists of 61 crystals which were glued together on a table with a teflon surface (Fig.1). During the glueing process and handling of the window the crystals could be fixed to the table by pumping between the table-surface and the crystals.

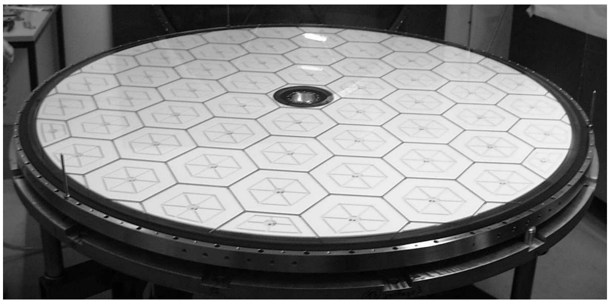

Fig. 1: The CaF_2 window is shown on the table on which is was glued. The steel flange holding the window was positioned using a movable support structure which is part of the table

The window was glued into a stainless steel flange via a viton membrane and is protected from both sides by radial spokes, supporting the window in the case of pressure differences between the detector and radiator gases. The window was brought into vertical position while it was still attached to the table and then carfully transfered to the detector housing using a crane. Manufactoring and handling of the window was performed in a grey room in the experimental area at GSI - Darmstadt.

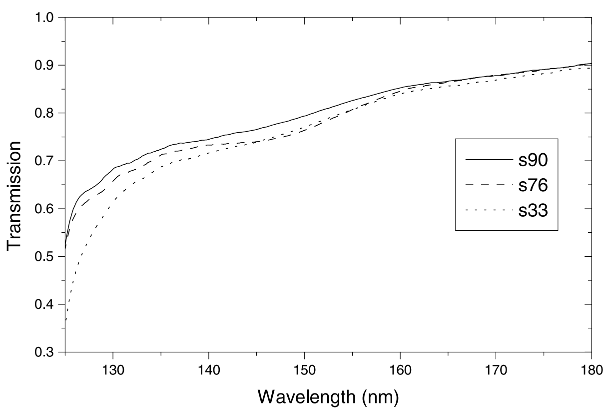

Fig. 2: Transmission curves of the CaF_2 crystals used to build the VUV window of the HADES-RICH detector

Prior to the manufacturing process, the VUV transmittance of all crystals had been measured. Examples of highest, medium, and lowest transmittance are shown in Fig.2. The VUV transmittance of the crystals used for the window is of high quality and by far superior to a first batch which had been tested last year [2]. The crystals were individually selected and positioned within the window surface in such a way that the highest transmittance is near the center where the intensity of the Cherenkov light is lowest.

Another component of the HADES-RICH detector is the CsI photodetector, used for single photon counting. Reproducible excellent results had been achieved in previous experiments on test samples coated with a resin stabilized graphite (RSG) layer [3], with about twice the efficiency as stainless steel substrate standard photocathodes.

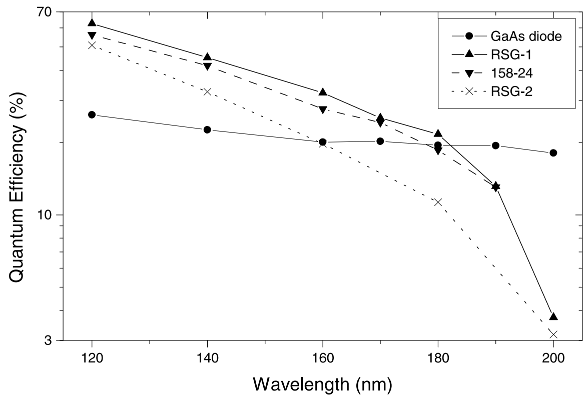

Fig. 3: Quantum efficiency curves of a two year old CsI-RSG sample (154-24), and fresh layers of CsI, coated on RSG substrates from different batches of graphite spray (RSG-1, RSG-2)), in comparison with a calibrated photodiode.

The mechanism of this enhancement, however, could not be clarified, yet, and CsI layers evaporated on RSG substrates from different batches of graphite spray, which obviously contained different solvents, showed strongly different performances (Fig.3). Results of some new investigations on test samples with enhanced quantum efficiency can be summarized as follows: No decrease in quantum efficiency could be observed after two years of storage in dry nitrogen as well as after exposure to ambient air for about two weeks. However, a decrease to zero in quantum efficiency at 190nm was observed in areas on the test samples, exposed to VUV radiation of about 1mC/cm^2 extracted charge, after a two week exposure to ambient air due to reaction of the CsI layer with water vapor. A work function modifying surface layer of a hydrophobe protecting substance, strongly bound to the CsJ layer, thus is supposed. First experiments with acrylic acid, a molecule assumed to obtain these properties, showed slightly enhanced quantum efficiency, but the results were not satisfying. A precise chemical analysis of the different graphite sprays will now be performed to clarify the differences in composition and elucidate the active substance(s).

References

[1] M. Böhmer *et al.*, this report, p.95
[2] W. Czech *et al.*, Jahresbericht 1998, p. 81
[3] J. Friese *et al.*, Nucl. Instr. Meth. **A438** (1999) 86