Surface Analysis
Technology

Vacuum
Components

S P E C S ®

Surface Analysis
System Software
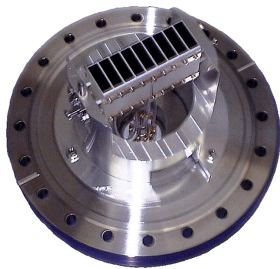
Computer
Technology

Lifetime tests of the PHOIBOS Extended Range Channel Electron Multiplier (CEM)

Application Notes

CEM array with
feedthrough

Introduction

The standard detector systems of the PHOIBOS analyzer series are based around the extended range CEM. This device is a specially formed and treated glass tube which has the effect of multiplying a single electron at the input to a pulse of around 10^8 electrons at the output. Because of the low resistance, the extended range CEMs are suitable for extremely high count rates.

A voltage between 2.5 - 3.5 kV across the cone and the tail-end initiates the electron multiplication. Electron multiplication is produced by the emissive layer along the inner surface of the channel. The gain is governed by the detector voltage and the condition of the emissive layer.

The condition of this layer changes with usage and to compensate for a drop in emissive quality of the surface, an increased detector voltage can be applied so to keep the overall gain constant.

If the detector voltage has reached the limit of 3.5 kV at this point the CEM is at the end of its life and needs replacing.

Experiment

The PHOIBOS SCD and a modified EQ 22 electron gun were installed on a UHV system without bakeout (base pressure 2×10^{-7} mbar). A constant count rate was measured in the flat region of a Cu AES spectrum for a few days. The beam current was increased several times during this period.

Figure 1: Ageing of the PHOIBOS Extended Range CEM. The detector voltage was increased if the counted rate had decreased
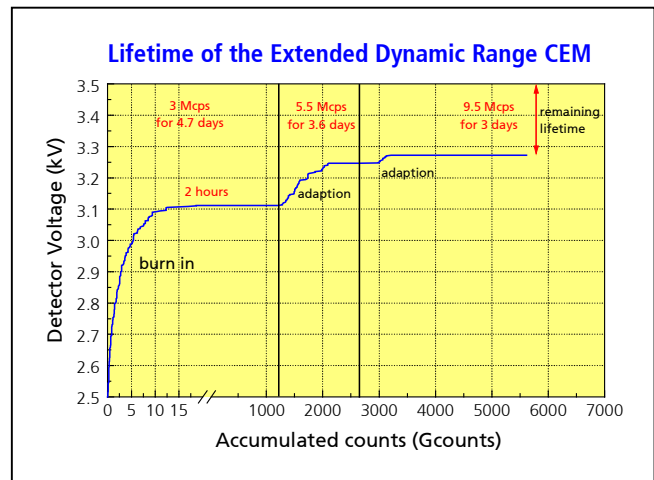
Conclusions

■ While the CEMs were not counting, residual gases in the system were adsorbed onto the channel walls which are kept clean by electron bombardment during operation. When counting was resumed, the gains were initially higher due to the increased work function by the adsorbed species.

■ When initially running a new CEM it needs approximately 20×10^9 counts for conditioning. Once properly conditioned, or "burned in", the surface on the semiconducting glass channel is quite stable.

■ The test results suggested that accumulations to 5×10^{12} counts and higher can be expected without serious degradation.

■ The extended range CEMs are suitable for extremely high count rates without serious degradation

Further studies
■ The ageing of the CEM due to the bakeout of the analyzer should be investigated.

References
[1] Channel multiplier compatible materials and lifetime tests, D. J. McComas et al., Rev. Sci. Inst. 55, 1984, 463-67.
[2] Gain Fatique Mechanism in Channel Electron Multipliers, R. H. Prince et al., Rev. Sci. Inst. 42, 1971, 66-71.