THGEM based VUV photosensor incorporating the THCOBRA for Ion Back Flow Reduction

J.F.C.A. Veloso¹, F. Pereira¹, C.A. Santos¹, C.D.R. Azevedo¹, F.D. Amaro², J.M.F. dos Santos², A. Breskin³, R. Chechik³

¹I3N, Physics Department – University of Aveiro, Portugal
²Physics Department – University of Coimbra, Portugal
³Department of Particle Physics – Weizmann Institute of Science, Israel

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Abstract

Ion Back Flow (IBF) in gaseous detectors present an operation drawback in many applications, such as in TPCs, RICH detectors, gaseous photosensors. Following the success of the MHSP, operating in flipped reverse mode[1], which has reached an IBF reduction close to $10^4$, a new concept based on it but with optimized geometry and with the goal of applications in large detection areas, was developed in a “thick-hole” configuration, the THCOBRA. It is produced like the THGEM structure[2], but including, in one of its sides, an extra electrode to trap the ions that flow from the multiplication stages. The operation of the THCOBRA is thought with the extra electrode facing against the electron multiplication region in such a way that not only ions that are flowing back from the multiplication region can be trapped in the extra electrode, but also the ones that are produced in its own hole multiplication region[3]. In this work we study a THGEM based VUV photosensor filled with Ne5%CH4 incorporating a THCOBRA between two THGEMs with a CSI photocathode deposited on the top of the first one. First results shows promising detector performance in terms of ion back flow reduction, detection efficiency and stable gain. Systematic studies of these parameters and overall detector performance as a function of the voltages applied to the different electrodes, namely, between anode and cathode ($V_{an}$) of the THCOBRA in a Ne5%CH4 atmosphere, are presented.

Motivation:

Gaseous photomultipliers
- Rich readout
- Photo detection in visible range

High Gain → Increase in number of ions flowing back

High Ion Back Flow (IBF)
- Feedback pulses
- Electric field distortions
- Photocathode (PC) aging

THCOBRA
- Ion trap device
- Based on THGEM technology

TH-COBRA geometry

<table>
<thead>
<tr>
<th>Actual Dimensions</th>
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<tbody>
<tr>
<td>Thickness = 0.4mm</td>
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<tr>
<td>RIM = 0.1mm</td>
</tr>
<tr>
<td>Hole diameter = 0.3mm</td>
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<td>Pitch = 1.0mm</td>
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Experimental Setup

Setting up Scheme

- Configuration based in a double layer THGEM with a flipped thick-cobra in between.

Detector Layout

- Voltage between Anode (A) and Cathode (C) to trap ions ($V_{an}$) → $V_a < V_c$

Gas: Ne/CH4 (95%/5%)

$E_{drif} = E_{induction} = 0 \text{ V/cm}$

Experimental Results

- Ion back flow of about 50% with full collection efficiency (CE)

- Relative and absolute values of IBF depend on the transfer field in an opposite way

Conclusions

- The implementation of THCOBRA’s in THGEM based photosensors for RICH detectors, working as ions traps – encouraging results were obtained;
- Similar values of gain compared to triple THGEM[4];
- Ion back flow down to 50% with full collection efficiency;
- A reduction of 20% of IBF is possible with a minor effect in the collection efficiency;
- There is still some room to play with the voltages in the different electrodes that may lead to a further reducing of the IBF.

References