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Innovative Micromegas Manufacturing with micro fabrication techniques and use of graphene

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Micromegas is a well-known micro-pattern gaseous detector with excellent properties in operation stability, position resolution, fast response, low ion feedback (about 10%) and good energy resolution. It can be adapted to detect the full range of particle radiation like photons, x-rays, neutrons, charged particles, alphas, nuclei etc. Micromegas implementation is based on PCB manufacturing technology. In this work, we propose an innovative fabrication process for micromegas structures using MEMS (Microelectromechanical systems) technology with potential improvements in micromegas properties, resulting from state-of-the-art microfabrication methods and novel materials. Graphene is a revolutionary material, a monoatomic carbon layer membrane with great properties, such as mechanical stability, high electrical conductivity and low ion transparency. Taking advantage of the excellent graphene properties, we aim at fully suppressing the ion feedback, when graphene is placed on top of the mesh electrode. A full exploration of potential benefits of the proposed layout will be attempted.

Our goal is to create a membrane mostly transparent to electrons and mostly opaque to ions. In order to fulfill these requirements, a novel membrane structure is under development. We have already succeeded in creating a mechanically stable support membrane on which a graphene monolayer is deposited. More specifically, consisting of 30 um-thick PDMS (Polydimethylsiloxane) membrane with through holes, acting as insulator layer, is bonded with a 5 um-thick Cu mesh. The fabrication process entails the steps that are described below: 1) construction of a Si/SU8 master so as to create by means of soft lithography a 30 um-thick PDMS membrane, bearing holes 50 um in diameter at a distance of 100 um, 2) transfer of the PDMS membrane to a modified glass carrier, 3) bonding of the PDMS membrane with a 5 um-thick Cu mesh, 4) creation of through holes in the copper layer, 50 um in diameter, via wet etching of copper through the PDMS membrane and 5) transfer of a graphene monolayer on top of the PDMS membrane. Ramman spectroscopy was used to confirm the graphene transfer uniformly on the PDMS membrane. We will present in detail the micro fabrication process and preliminary results concerning the electron transparency.

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