NEW MICRO PATTERN GAS DETECTOR BASED ON A 2D POSITION READOUT MESH

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Abstract

Micro pattern gas detectors (MPGD) could become suitable devices to carry out time-resolved X-ray diffraction experiments in the sub-millisecond time scale at synchrotron radiation facilities. This is because the small anode-cathode distances in these devices allow short ion drift times, thus reducing one of the most important count rate limitations, i.e. space charge effects. This results in potentially very high local count rates. In addition, the possibility to manufacture electrode structures with high electrode densities offers the prospect for excellent spatial resolution. Nevertheless, these devices are not free of problems. Among other problems: the build-up of ions in the detector components; the susceptibility of the materials in the structure to dielectric breakdown, and; the non-uniformity of response over large areas. Here we present a new MPGD design we have called Micro Reading Mesh Chamber (MRMC).

Its layout (see Figure 1) is based on a resistive anode (red), support pillars (green) and a mesh formed by two planes of pick-up strips (yellow and orange).

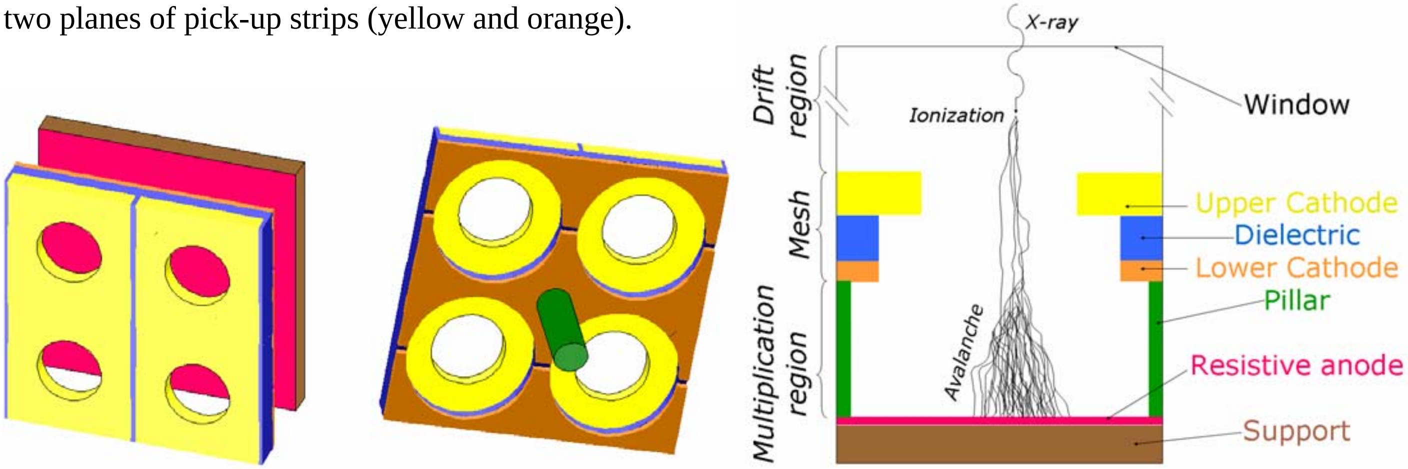

Figure 1. View of the mesh and the anode from the window (left), view of the mesh and the pillars from the anode (center) and lateral view of the whole structure (right).

In order to improve the cathode signals quality, we use the mesh to read the avalanche. In this manner the size of the induced charge is larger than in more conventional geometries. It allows lower multiplication field intensities, what reduces formation of sparks, keeping the same detection efficiency. Moreover, a resistive anode has been designed to quench the sparks at an early stage. With the aim of preventing charging up, a common problem with GEMs and MPGD in general, a minimum amount of dielectric material has been used in the design. The aim has been to avoid dielectric near the drift paths of the ions. Finally, the use of one pillar every four cells guarantee good gain uniformity.

In this work we report on the development of this detector. We show several detailed simulations of every aspect of the MRMC such as the gas properties, the electron and ion drift characteristics, a complete model for the multiplication including the space charge and the resistive layer effects, the signal formation, the crosstalk between tracks… The optimization process of the different parameters of the detector (geometry, electric fields, anode resistivity…) is also shown. Finally, we report on the building up technique and capabilities.

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