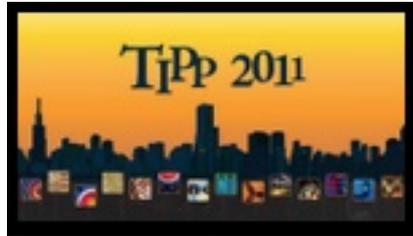


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A new solid state tracking detector: Electron Emission Membranes and a MEMS made vacuum electron multiplier

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Content :

When a minimum ionizing particle crosses an aluminium foil, at least one low energy electron is emitted, at the crossing point, in about 6 percent of the cases. With low work function materials (ceramics, or CsI, diamond), this probability may be much higher. Since only the skin of the foil participates, the efficiency to emit at least one electron can be increased by surface enlargement (meandering, fractalizing). In addition, a strong electric field may enhance the electron emission efficiency. We intend to develop membranes with an electron efficiency of 50 - 99 percent.

For multiplying the single electrons we intend to develop a MEMS made multiplier, in vacuum, to be applied on a pixel chip. The multiplier consists of a stack of some 5 ultra thin (15 - 200 nm) thick membranes of a suitable material (strong, low work function, high-resistivity) like diamond, Si-rich SiNitride. An incoming electron, accelerated up to ~ 200 eV will cause electrons to be emitted from the back side of a membrane after its impact at the front side. Such a membrane may have a 'secondary electron' yield of up to 10. With ~5 membranes, sufficient gain is achieved in order to activate the pixel circuitry. Due to the very small source capacitance at the pixel input pad, a good time resolution is possible. The spatial resolution is only limited by the pixel size.

Instead of applying an Electron Emission Membrane, the electron multiplier could be combined with a classical photocathode of a photomultiplier. This results in the Timed Photon Counter (TiPC or Topsy). This is a photomultiplier, but with a superior position and time resolution per photon (10 microns, 10 ps resp.), thin and planar, and capable to operate in magnetic fields. With Topsy, instant 3D photos can be made by a time-of-flight measurement.

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