Performance of Passivated Glass Micro Strip Gas Chamber

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Motivation

High rates ions accumulate on the space between metal strips

e up → limits the rate capability

Solutions:

For intermediate resistive substrates

(Previous talk)

BUT

Yet commercially available as thin (0 μm) sheets

MSGC on a thin substrate and a thin film (<1 μm) of desired properties

Film coats rough electrode edges to improve breakdown behavior (high gains)

The name PASSIVATION
### Over-coated MSGC

Detector Films

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Coating Material</th>
<th>Thickness [μm]</th>
<th>R [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>moscow glass (Fe-V)</td>
<td>0.02 - 0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>phosphate glass (P₂O₅)</td>
<td>0.02 - 0.1</td>
<td></td>
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<td>moscow glass (Fe-V)</td>
<td>0.02 - 0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ion implanted Kapton</td>
<td>0.3 - 0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>amorphous silicon</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>carbon</td>
<td>0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>electronic glass</td>
<td>0.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

65 (1985) 54-58
Beam Sputtering

- Pumping ~1 hour
- Sputtering 5-10 hours
- Deposition speed ~0.05 μm/h
Plasma Sputtering

MSGC holder

hermetic b

~ 10 mTorr

plasma

Si target

RF generator

13.6 MHz
100-200 W
Kapton Coating

polymer drop

Spin on very thin Kapton (~0.3µm)

ρ_{raw kapton} \approx 10^{17} \Omega

30\text{keV} H\ ions

ion implant depth > 0.1

ρ_{ion implanted Kapton} \approx 10^9 \Omega

untreated Kapton \leq t_{RF plasma} < t_{ion beam sputter}
Coating

0.02-0.1 micron moscow glass

ρ ~ $10^9-10^{10}$ Ω cm

on photomask glass

Tested in Ar-isobutane 9:1

ion beam sputtering

Response of MSGC A to $^{55}$Fe
(energy resolution = 15% at 6 keV)

Gain curve

DPF 96, AC
Coating
0.02-0.1 micron phosphate glass
\( \rho = 10^9 \, \Omega \, \text{cm} \)
on photomask glass
Tested in Ar-isobutane 9:1

Ion beam sputtering

detector as A but semiconductive layer or resistivity.

![Gain curve](image)

Suppression due to the lower surface ity
Coating

0.02-0.1 micron moscow glass
\( \rho \sim 10^9-10^{10} \, \Omega \, \text{cm} \)
on photomask glass

Tested in Ar-isobutane 9:1

MSGC A, but smaller pitch.
in (x20) at same voltage, but largest
ain is smaller than for MSGC A.

Coating

0.3-0.5 micron spun on Kapton which
subsequently was ion implanted
on photomask glass
\( R \sim 10^{12}-10^{14} \, \Omega / \square \)

Tested in Ar-isobutane 9:1

such a Kapton-coated detector was
\textbf{Very fast coating method!}

\begin{itemize}
  \item ain due to smaller resistivity.
  \item Energy resolution (30\%) possibly due to
    \textbf{thickness of layer.}
\end{itemize}
Coating

1 micron amorphous silicon (a-Si:H)

$\rho \sim 10^8 \ \Omega \ cm$
on sapphire (0.4 mm thick)

$R \sim 2 \times 10^{15} \ \Omega / \square$

Tested in Ar-isobutane 9:1

Aromatic way to passivate than ion beam sputtering

It is obvious that charge transport through this layer

**RF plasma sputtering**

**Cr x-rays.**

@ 50kHz/mm$^2$

Steady state current variation smaller than $\epsilon$
Coating

0.1 micron carbon
ρ ~ 10^8 Ω cm
on photomask glass
R ~ 4 \times 10^{12} Ω / □
Tested in Ar-isobutane 9:1

not to coat with carbon by ion beam sputtering.

Response to Cr x-rays.
FWHM = 19% @ 60kHz/mm^2
and gas gain = 50

Dark current under irradiation. Stability of co
Coating

0.1 micron electronic glass
ρ ~ 10^{10} Ω cm

on photomask glass

R ~ 2 \times 10^{15} Ω / \square

Ar-isobutane 9:1 and Ar-DME 9:1

Response to Cr x-rays.
FWHM = 15% @ 100kHz/mm^2
gas gain = 1,000; drift field = 185 V/cm

Gain curve for different quenchers (diamonds = is; triangles = DME); drift field = 185 V/cm.

limit 400 kHz/mm^2 at a gas gain of 1500.
Preliminary Aging Test of MSGC
(200 μm pitch, ion beam sputtered glass coating)

Steel high purity gas system, but some fell in contact with gas.

Experiments with DME and one with i-C₄H₁₀ of 10% after:

n using purified isobutane (etching of)

n using unpurified DME (99.8%) (no

DPE 06, Av
Status of our Tests with Coated MSGCs

and a wide variety of coating materials to be candidates for coating of MSGCs.

ed detectors show a **good energy resolution** ($\gamma$ 6keV) and **high gains** ($10^3-10^4$) as long as
ness and the resistivity of the coating material is correctly.

Electronic stability of some coatings were **unstable** and are eliminated for further testing.

stability of the coating to the strate over time and during the avalanche appears potential problems and needs to be

Upcoming Experiments

o avoid problems that might arise from the slowness we have coated a set of ILL6C MSGC's (Switzerland) made of D263. In an upcoming
ment we will use the identical experimental set-up compare the performance of coated versus un-coated detectors directly.