Date: Mon, 28 Aug 2006 13:25:34 -0400 (EDT)
From: "Dipangkar Dutta" <ddutta@tunl.duke.edu> Block Address
Subject: AW: AW: Diamond pixel detectors (fwd)
To: dd285@msstate.edu

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Date: Tue, 1 Aug 2006 21:45:44 +0200
From: Berdermann Eleni <E.Berdermann@gsi.de>
To: Dipangkar Dutta <ddutta@tunl.duke.edu>
Subject: AW: AW: Diamond pixel detectors

Dear Dr. Dutta,

Sorry for delayed answer. Its a busy time ...

It's clear now that you have to deal with electrons being above minimum ionisation, already in the relativistic rise of the energy loss curve.

Consequently, you should use a so called EL DG (Electronic, Detector Grade) PolyCrystalline
CVD diamond sample of the dimensions you need (available up to 100 mm diam. wafers).
The standard thickness of this material is about 500 µm.

For the estimation of the required electronics, please use the following numbers:
A mip in diamond produces 36 e/µm. You can collect about the half of the produced charge,
i.e. for a 500 µm thick detector about 9.000-10.000 e/mip. If you have a charge-sensitive amplifier able to work with those 15-20 kHz rates, just use it. Broadband amplifiers are too noisy for this application.

The strip design you mentioned is not at all a problem to be be produced on PC CVDD.
What I mentioned with "dot electrodes" is simply the use of an easy structure to be metallized in any lab (I'm sure also in the Jefferson Lab) by using mechanical masks
and exercise a bit the use of diamond detectors. Its not because its not possible to apply the required strip design. The RD42 Collaboration has strip detectors with a pitch of 50 µm and a strip width of 25 µm.

I wish you good luck for your detector.

Best regards

Elèni

> -----Ursprüngliche Nachricht-----
> Von: Dipangkar Dutta [mailto:ddutta@tunl.duke.edu]
> Gesendet: Freitag, 28. Juli 2006 04:28
> An: Berdermann Eleni
> Betreff: Re: AW: Diamond pixel detectors
>
>
> Dear Dr. Berdermann,
> Thank you very much for your prompt reply. The information you have
> provided will be very helpful. Here are some of the details
> on the compton polarimeter recoil electron detector.
> Indeed this detector is needed for the recoiling electrons
> from the green
> laser photon Compton scattering off an electron beams ranging
> in energy
> from 1 to 9 GeV. So the energy of the detected electrons will
> also be in
> the 1 - 9 GeV range. The scattered photon will be detected in
> a photon
> calorimeter (lead scintillator) in coincidence with the
> recoiling electron. The primary electron beam and the
> scattered electron beam is bent by a

> series of 4 dipoles (which form a chicane) and so the momentum of the
> recoil electron can be measured my measuring its deviation from the
> primary beam after these magnets. The range of these
> deviations is usually in the order of 1-2 mm and they are
> usually 4-6 mm away from the primary
> beam (i.e. compton edge is 4-6 mm from the primary beam).
> Thus we need ~
> 200-250 micron resolution to measure their momentum
> accurately. Since the Compton edge is just 4-6 mm from the
> primary beam the detector needs to
> be inside the beampipe. Which makes it vulnarable to
> accidental exposure
> to the primary beam or beam halos for badly tuned beams etc.
> Hence they need to be rad hard. The beam electron current
> will range from 10 - 180 micro Amps. At 180 micro amps the
> electron rate per strip will be 15-20KHz/strip.
>
> These are fairly modest requirements. We have used Si strip
> detectors for lower currents but they get damaged by radiation.
>
> I did see some examples on the web of the dot electrodes you
> mentioned. If these are the devices which are more readily
> available I am sure we can
> string together a row of dots as one readout channel and
> thereby achieve
> the needed strip like behavior.
> So please let me know if you have any more information on the type of
> detector you would recommend based on these details.
>
> Thank you very mucg for your time
> Dipangkar Dutta
>
>
>
> On Thu, 27 Jul 2006, Berdermann Eleni wrote:
>
> > Dear Dr. Dutta,
> >
> > since I'm not familiar with your special "Compton Polarimetry"
> > application, I should first understand better your measurement in
> > order to answer correctly:
> >
> > 1) Those "recoil electrons" you want to detect with the diamond
> > detector, are they the scattered beam electrons on the
> laser photons?
> >
> > 2) What is the energy of those electrons?
> >
> > 3) What is the expected electron rate/strip to be detected?
> >
> > The latest is the crucial parameter defining the type and
> thickness of
> > CVD diamond you could try to use, and the corresponding electronics
> > too.
> >
> > The status of CVD diamond detectors is a long story, because the
> > versatility and rad. hardness of the material led to a very broad
> > range of detector applications in the past. You can find plenty of
> > literature just asking Google.
> >
> > However, no CVD diamond detector for such applications
> exists "ready
> > to used" on the market. The procedure is to buy first a suitable
> > sample. Our supplier is: Element Six, Ascot, UK. If you
> like you may
> > use my name for getting easier contact; the contact person for
> > detectors there is Kevin Oliver, email: kevin.oliver@e6.com ,
> > unfortunately currently in vacation.
> >
> > Second: to find a manufacturer able and willing to do the
> > photolithography needed for the strip-electrode design.
> Your required
> > position resolution is no problem. It is in principle
> rather similar
> > procedure as for silicon detectors, however, not many
> companies like to do. You may ask Kevin Oliver too; probably

> they can take care about masks and metallisation. My
> recommendation however is: if you never have work with a CVD diamond
> detector, don't start with a complicated micro-strip design.
> Go familiar with it with simple dot electrodes, and
> remetallize it afterwards.
> >
> > Concerning the costs: again, it belongs strongly to the type of
> > diamond you need.
> >
> > Thats why, please tell me first a bit more about the
> parameters of the
> > electrons you like to detect. I can then be of better assistance.
> >
> > Best regards
> >
> > Elèni Berdermann
> >
> >
> >
> >
> >> -----Ursprüngliche Nachricht-----
> >> Von: Dipangkar Dutta [mailto:ddutta@tunl.duke.edu]
> >> Gesendet: Donnerstag, 27. Juli 2006 17:12
> >> An: Berdermann Eleni
> >> Betreff: Diamond pixel detectors
> >>
> >>
> >>
> >> Dear Dr. Berdermann,
> >> I was wondering if we could ask you a few questions about CVD
> >> Diamond detectors. We are interested in using the diamond detectors
> >> as a recoil electron detector in a Compton Polarimeter at
> >> Jefferson Lab. The
> >> sensitive area will be 3x3~cm and it needs ~ 250 micron
> >> resolution in the transverse direction. Our main concern is
> >> radiation hardness. It seems the
> >> diamond detector would be ideal for our application, however
> >> it was not clear to us what is the current status of R&D for
> >> these detectors and if we can buy
> >> some diamond strip detectors. We would be very grateful if
> >> you could guide
> >> us to where we can get such detectors and how much they
> might cost.
> >>
> >> Thank you very much
> >> Dipangkar Dutta
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