Resistive Coatings for Gaseous Detectors
RCGD 2019

Workshop on

Diamond Like Carbon based Micro Pattern Gaseous Detectors

Idea: short topical workshop to DLC based MPGD detectors
Length: 2 days
Foreseen: **Tuesday 14 - Wednesday 15 May 2019**

- i.e. Tuesday and Wednesday directly after the MPGD Conference 5-10/05/19 La Rochelle

Scientific Program:

The introduction of Diamond Like Carbon in MPGD detectors has opened the doors to make new high rate capable MPGD structures that are spark-resistant, can achieve high gains with a single amplification stage, are easier to build and can allow for order-of-magnitude improvement in time resolution. Many of the recently introduced MPGDs are based on Diamond Like Carbon as a resistive electrode: uRWELL, uPIC and FTM, while several other detector structures are investigating the possibilities of using resistive coatings.

Crucial for the development of these detectors is the deposition of high quality, robust, Diamond Like Carbon (DLC) films on Flexible Copper Clad Foils (FCCL) made of PolyImide (PI), with low internal stress and good adhesion to the base substrate and with stable (in time) highly uniform surface resistivity. Furthermore MPGDs have demonstrated extreme radiation hard capabilities, the introduction of a new material (DLC) need to be thoroughly validated.

This requires good understanding of what is happening in the material during deposition and during the various detector production stages, often characterized by high temperature gradients, high pressure, the use of highly active chemicals (KOH and XXX) and mechanical techniques (sandblasting), as well as what is happening during detector operation, with gasses such as Ar, CO2, CF4 and Freons. The robustness of DLC in an environment with free F• radicals and HF acid need to be understood.

In this workshop we would like to review the current status of the DLC based detectors and DLC deposition techniques and identify the road towards successful production and testing of these detectors along with scaling up to large area prototypes. In particular we will discuss the production and quality of the resistive coatings made of DLC with different production techniques, the etching of the amplification structures

We will allow time for in-depth discussion and hope to form (informal) collaborations between, the different detector technologies (uRWELL, FTM, uPIC, ...) and different DLC deposition techniques (magnetron sputtering, pulsed laser deposition, ...) to address the current challenges, as well as identify the areas where common R&D is necessary such as the development of simulation tools for resistive detectors.

Participants: 20-30 (estimated)

For the Scientific Committee:

We approach the DLC from the *"Users perspective"*: we are interested in what happens in the DLC material during deposition as well as what happens during various detector production stages as well as during long time operation in radiation environment. We need to ask the Solid state / DLC community what we are interested in and steer the contributions in this direction: stability, robustness, resistivity, adhesion under different pressure, temperature and radiation conditions. We need to show to the DLC experts how we build our detectors, under which conditions we use them and give them a detailed and in depth overview of the various detector production stages. Simulation is a tool to understand what is happening at microscopic level, either during the fabrication process (internal stress, adhesion of DLC to PI, …) as well as during detector operation (time resolution, detection efficiency, charge spectra, induced signal on various strips). For the former the expertise is entirely in the Solid State Phyics community, and it would be important to stabilize links and setup collaborations. For the latter, detector simulation, we have the expertise in our community, together with a tool, Garfield(++), that simulates well detectors with conductive electrodes, but cannot simulate the effects of resistive materials. Furthermore, the simulation manpower in our community is small and should not be dispersed. Therefore a detailed plan to develop such tools need to be designed.

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Example of a Workshop Schedule

Introduction to the workshop

Past Experience Session

Early DLC experimentation (including work on MSGC)	- Colas
DLC for MM & uPIC detectors made in Japan	- Ochi
Etching of DLC coated PI foils & detector production	- Rui De Oliveira
uRWELL experience with sputtered DLC	- Bencivenni
The birth of the FTM detector	- Marcello Maggi
DLC Detectors made in China	- Zhou Yi

Diamond Like Carbon Session

Diamond Like Carbon: state of the art	- international expert

Overview of DLC Ageing	- international expert
Overview of different DLC Deposition techniques	- expert
Magnetron Sputtering in Japan	- Ochi
Magnetron Sputtering in China	- Lunlin
Pulsed Laser Deposition	- Caricato
Ion beam Deposition	- Valentini
DLC Characterization Measurements	- Serra
Discussion	

Simulation session

Ab-initio simulation of DLC material	- ???
Simulation of attachment of DLC to other material	- ???
Simulation of Resistive detectors with SPICE	- F. Fallavolita / M. Maggi / A. Ranieri
Implementation of resistive layers in Garfield	- Rob Veenhof / Supratik
Identification of a simulation roadmap	- all

Road(s) towards the future

→ what are the current challenges, applications, what are the next steps

Discussion - All

Further Ideas:

- Werner Riegler on modelling resistive detectors

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For the Local Organising Committee:

Costs (to be detailed further)

Fee: 150EUR including reinforced coffee breaks & 1 social dinner. Excl lunch (there are enough good places for quick or longer lunch just outside the campus in Bari)

Invited speakers: if we get ~2kEUR funding from INFN we could invite 2 people some solid-state DLC experts.

Funding:

- Uni SAL: 1kEUR approved
- INFN BA: 2kEUR requested
- Who else can we ask? Uni BA? Poliechnico? CEDAD?

Conference Venue: INFN Bari Aula Multimedia or we could get a nice room in the center from the University (Ateneo)