Low Density Materials for Beam Instrumentation Workshop

Report of Contributions

Contribution ID: **2**　　　　　　　　　　　　　　　　　　　　Type: **not specified**

Screens for BTV instrumentation

Tuesday 20 June 2023 09:20 (20 minutes)

Screen based instruments are commonly used in particle accelerators for beam steering, observation and size measurements. After a short introduction to this type of instrumentation deployed all along the accelerator chain at CERN, the presentation will focus on the experimental beam tests recently done on new type of screens made of nanotube material: CNT and BNNT. This was performed on the HiRadMat facility which can provide high intensity together with small beam size. Setup of the experiment and results will be discussed.

Presenter:　BURGER, Stephane (CERN)

Session Classification:　Beam instrumentation needs 1/2

Contribution ID: 4　　　　　　　　　　　　　　　　　　　　　Type: **not specified**

Experience with CNT wires in high electric field

Tuesday 20 June 2023 09:40 (20 minutes)

Because of the increased radioactivity in LSS2 (SPS slow extraction towards north area), new low-Z materials were studied for use in electrostatic septa. Carbon Nano Tubes wire (CNT) was the first candidate to be studied. A test facility was built to assess the behaviour of the CNT wires in high field conditions.

Presenter: JORAT, Louise Olivia (CERN)

Session Classification: Beam instrumentation needs 1/2

Contribution ID: **6**   Type: **not specified**

Use of CNT fibers for the beam instrumentation with wire-scanners

Tuesday 20 June 2023 10:00 (20 minutes)

Wire-scanners are instruments frequently used in particle accelerators for the measurement of the transverse profile. The challenge of increasing brightness necessitates innovative solutions. Carbon fibers currently used will not respond to the new boundaries of future projects. Carbon nanotube (CNT) fibers could offer new materials with these materials in wire-scanner construction enhances performance and accuracy, addressing the demands of higher beam intensity. This presentation shows the preliminary results of the irradiation at high energy and high intensity of CNT fibers.

Presenter: MARIET, Alexandre (CERN)

Session Classification: Beam instrumentation needs 1/2

Contribution ID: **8**   Type: **not specified**

Nanomaterials and CNTs in ISOLDE targetry

Tuesday 20 June 2023 10:50 (25 minutes)

CERN-ISOLDE is a facility dedicated to the production of radioactive ion beams (RIBs) for physics research.
The quality and quantity of available RIBs is governed by the choice of target materials and their microstructural properties.
In this contribution we highlight the potential of nanomaterials and carbon nanotubes in target material development for more efficient isotope extraction and improved RIB yields.
We will give an overview over past experiences as well as current developments.

Presenter: Dr STEGEMANN, Simon Thomas (CERN)

Session Classification: Beam instrumentation needs 2/2

Contribution ID: **10**   Type: **not specified**

Use of low-density graphitic materials for beam-intercepting devices

Tuesday 20 June 2023 11:15 (25 minutes)

The presentation will cover the use of graphitic materials in beam intercepting devices.
Particular focus will be given to the LHC external dump (TDE), characterising the different materials that are employed in the dump and those that are under study for the HL-LHC upgrade.
A detailed breakdown of the R&D program for this application will cover the simulation and experimental techniques as well as the post-irradiation examinations and results.
Finally, the upcoming procurement efforts are going to be detailed, together with the related strategy for material qualification and quality assurance.

Presenter: SOLIERI, Nicola (CERN)

Session Classification: Beam instrumentation needs 2/2

Contribution ID: **12**   Type: **not specified**

General introduction

Tuesday 20 June 2023 08:45 (15 minutes)

Presenter: LEFEVRE, Thibaut (CERN)

Session Classification: Welcome

Contribution ID: **13** Type: **not specified**

Workshop introduction

Tuesday 20 June 2023 09:00 (20 minutes)

Presenter: VENESS, Raymond (CERN)

Session Classification: Welcome

Contribution ID: **14**   Type: **not specified**

Presentation of CMNR's µRobotex station, handling carbon nanotubes and measuring flexoelectricity

Tuesday 20 June 2023 15:55 (30 minutes)

As part of a study on the properties of carbon nanotubes, we are going to briefly present the micro-Robotex station, which consists of a Zeiss Auriga 60 scanning electron microscope, on which are installed a Focused Ion Beam-FIB from Orsay Physics, a Gas Injection System-GIS from Oxford Instrument, and a robot with 6 degrees of freedom installed inside the vacuum chamber. By manufacturing suitable tools, we can present a preliminary study to detect and characterise the principle of flexoelectricity of CNT using brightness measurements. Some key results from the micro-Robortex station will also be presented.

Presenter: RAUCH, Jean-Yves (Université de Franche-Comté)

Session Classification: Manipulation

Contribution ID: **16**   Type: **not specified**

Microscopic characterization activity at CERN

Tuesday 20 June 2023 16:25 (30 minutes)

The microscopy team at CERN is devoted to providing material characterization including topographical imaging, morphology, phase identification and chemical analysis through the utilization of Scanning Electron Microscopy (SEM), Focused Ion Beam (FIB)-SEM and X-ray Diffraction (XRD). Material characterization is carried out on a wide range of materials with emphasis on metals and alloys, which display great compatibility with electron microscopy apparatus, along with ceramics, composites and thin film specimens. We will present specific examples of how these techniques are utilized to extract the maximum possible information from samples that are either being installed or extracted from the detectors and accelerator complex.

Presenter: PEREZ FONTENLA, Ana Teresa (CERN)

Session Classification: Manipulation

Contribution ID: **22**   Type: **not specified**

Nanoscale materials by gas-phase FCCVD synthesis: structure and properties

Wednesday 21 June 2023 09:00 (40 minutes)

Floating catalyst CVD is the universal route to grow 1D nanoparticles, such as nanotubes and nanowires, in the gas phase and collect them in the form of freestanding nanotextiles, non-woven mats, and fibres. Due to high aspect ratio of constituent nanoparticles and network structure, macromaterials of CNTs exhibit high mechanical and electrical properties coupled with high flexibility and inherent damage-tolerance. The talk will give an overview on the structure and properties of CNT-based materials and recent achievements of IMDEA Materials on synthesis of nanotextiles of different chemistries.

Author: MIKHALCHAN, Anastasiia (IMDEA)

Presenter: MIKHALCHAN, Anastasiia (IMDEA)

Session Classification: Characterization

Contribution ID: **29**   Type: **not specified**

Mechanical and physical characterization of small scale specimens

Wednesday 21 June 2023 09:40 (20 minutes)

MME Mechanical and Materials laboratories undertake thermophysical and mechanical measurements for a wide range of components and devices at CERN, and uses state-of-the-art techniques to provide the necessary inputs for the analyses, and validate them experimentally. Thus, these laboratories constitute a crucial resource in supporting critical equipment throughout its lifecycle, from conception to commissioning and operation monitoring.

Presenters: AVILES SANTILLANA, Ignacio (CERN);   SACRISTAN DE FRUTOS, Oscar (CERN)

Session Classification: Characterization

Contribution ID: **35**　　　　　　　　　　　　　　　　　　　　Type: **not specified**

Simulation of beam interaction with thin wires - FLUKA and COMSOL codes

Wednesday 21 June 2023 10:50 (20 minutes)

Calculation of the energy loss of an incident beam in a thin wire is the first step if we want to assess the thermal behaviour of the wire during the scan process. We will present these calculations with the FLUKA code and the choice of key parameters to get realistic results. Simulations at specific energies for SPS (450 GeV), LHC (7 TeV) and FCC (50 TeV) were performed with different densities and C-Fe weight content and will be discussed. Thermal behaviour will also be quickly broach.

Presenter:　GROETZ, Jean-Emmanuel (Chrono-Environnement)

Session Classification:　Simulations

Contribution ID: **37**   Type: **not specified**

Thermal simulation for wire-scanners

Wednesday 21 June 2023 11:10 (20 minutes)

Low-density materials as targets for wire scanners demonstrate favorable thermal behavior. Simulations with the PyTT package are carried out to study the secondary emission yield and the maximum temperature for carbon nanotube and carbon fibre wire for the PSI Main Ring Cyclotron and HL-LHC beams. These results show that with low-density materials, the maximum temperature reached is lower due to the smaller amount of material and, for the PSI beam, the thermionic emission current, which represents a major perturbation to the measured signal, is completely suppressed.

Presenter: BOUCARD, Manon (EPFL - Ecole Polytechnique Federale Lausanne (CH))

Session Classification: Simulations

Contribution ID: 43
Type: **not specified**

Chair conclusion / discussion

Presenter: STORA, Thierry (CERN)

Session Classification: Lunch break

Contribution ID: 44 Type: **not specified**

Free-standing CNT membranes

Tuesday 20 June 2023 14:10 (25 minutes)

Canatu's carbon nanotube membrane is the world's thinnest and strongest CNT membrane, exhibiting high transmittance (>97%T at EUV/X-ray), low flare and high thermal stability (>1500℃). Membrane made with Canatu carbon nanotubes have extraordinary mechanical, thermal and optical properties, making them ideal for extreme conditions, such as EUV pellicles in the semiconductor industry and X-ray windows in space applications.

Presenter: VARJOS, Ilkka (Canatu)

Session Classification: Material procurement

Contribution ID: 45   Type: **not specified**

Ultra-long carbon nanotube forest via in situ supplements of iron and aluminum vapor sources

Tuesday 20 June 2023 14:35 (25 minutes)

A carbon nanotube forest with a length of 14 cm grew with an average growth rate of 1.5 µm s−1 and a growth lifetime of 26 h. Several key factors to realize this unprecedented long growth such as catalyst conditions, growth conditions in chemical vapor deposition, and reactor system were clarified. The long carbon nanotube forest enabled macroscopic measurements of the tensile and electrical properties of the carbon nanotube wires.

Presenter: SUGIME, Hisashi (Kindai)

Session Classification: Material procurement

Contribution ID: 46 Type: **not specified**

High-Performance Galvorn CNT Materials

Tuesday 20 June 2023 15:00 (25 minutes)

DEXMAT produces Galvorn CNT materials using a proprietary fluid phase production method. This method produces CNTF in which the CNT molecules are highly aligned along the fiber axis, resulting in high strength, electrical conductivity, and thermal conductivity along the axis of the fiber. Compared to a copper wire with the same diameter, a CNTF produced by this method has 12 times higher strength, more than 6 times lower density, at least 25 times higher flexure tolerance, and up to 50% higher thermal conductivity.

Presenter: TSENTALOVICH, Dmitri (Dexmat)

Session Classification: Material procurement

Contribution ID: 47   Type: **not specified**

Chair conclusion / discussion

Presenter: SGOBBA, Stefano (CERN)

Session Classification: Coffee break

Contribution ID: 49 Type: **not specified**

How high-power accelerators damage thin wires

Tuesday 20 June 2023 11:40 (25 minutes)

Thin targets are used in high-power accelerators because of low energy deposited by the beam and fast cooling.

Extreme beams test the limits to those structures. A series of damage tests done on CERN machines on carbon fiber targets used in wire scanners is presented. Damage events observed on PSI machines on carbon fibers and molybdenum wires are discussed.

Presenter: SAPINSKI, Mariusz (Paul Scherrer Institute (CH))

Session Classification: Beam instrumentation needs 2/2

Contribution ID: **52**   Type: **not specified**

Chair conclusion

Tuesday 20 June 2023 16:55 (15 minutes)

Presenter: DEVEL, Michel (SupMicroTech)

Contribution ID: 55   Type: **not specified**

Chair conclusion / discussion

Wednesday 21 June 2023 11:30 (15 minutes)

Presenter: RONCAROLO, Federico (CERN)

Contribution ID: 56   Type: **not specified**

Chair conclusion

Tuesday 20 June 2023 10:20 (15 minutes)

Presenter: VENESS, Raymond (CERN)

Contribution ID: 57   Type: **not specified**

Chair conclusion

Tuesday 20 June 2023 12:05 (15 minutes)

Presenter: STORA, Thierry (CERN)

Contribution ID: **58** Type: **not specified**

1D and 2D Nanomaterials Fabrication, Purification and Utilisation

Tuesday 20 June 2023 13:50 (20 minutes)

The presentation will provide an overview of the 1D and 2D nanomaterials synthesis capabilities at the University of Bath and some initial ideas to develop carbon nanotube-based ropes for CERN's wire scanner application.

Presenter: MATTIA, Davide (Bath)

Session Classification: Material procurement

Contribution ID: **59** Type: **not specified**

Chair conclusion

Tuesday 20 June 2023 15:25 (15 minutes)

Presenter: Dr SGOBBA, Stefano (CERN)

Contribution ID: **60**   Type: **not specified**

Mechanical characterisation of braided carbon nanotubes for wire scanners

Wednesday 21 June 2023 10:00 (20 minutes)

The increased luminosity of future particle accelerators will require improvements to beam instrumentation techniques and materials. A promising route for future wire scanners is the use of braided carbon nanotubes which have an exceptional combination of mechanical and thermal characteristics. This study outlines initial investigations into the effects of braiding on mechanical performance and routes to reliably model these systems.

Presenter: LUNT, Alexander (University of Bath (GB))

Session Classification: Characterization

Contribution ID: **61**　　　　　　　　　　　　　　　　　Type: **not specified**

Chair conclusion

Wednesday 21 June 2023 10:20 (15 minutes)

Presenter: Dr CALVIANI, Marco (CERN)