AKBP 8: Radiofrequency Systems 2 – Superconductivity

Time: Tuesday 16:00–17:30 Location: AKBP-H14

AKBP 8.1 Tue 16:00 AKBP-H14

Implementation of Nb3Sn co-sputtering for copper cavity coating — •Sara Amidi, Nils Schäfer, Márton Major, and Lambert Alff — TU Darmstadt, Darmstadt, Germany

Thin-film coatings play a crucial role in the superconducting industry. One method of depositing them on a substrate is by using the magnetron sputtering method. The aim of this project is to design a system that can deposit a superconductive coating of Nb3Sn with uniform thickness on the interior side of a copper RF cavity system with TESLA geometry. As the first step in the project, Particle in Cell Monte Carlo (PIC-MC) and Direct Simulation Monte Carlo (DSMC) methods along with the simulation of the thin film deposition using NASCAM software will be investigated. Then based on the result, the practicality of the application of the numerical methods to the RF cavity is inspected and process parameters of the experimental method are improved. However, to have a uniform film thickness across the cavity, the deposition rate needs to be adjusted and we are planning to do that with a unique design of the magnetron system. An idea would be to change the design of the magnets i.e., using a hollow cathode magnetron (HCM) or post cathode magnetron instead of a magnetic rod. In addition, the number of the cathodes and their location in the system have significant importance. Our team would like to appreciate BMBF for funding this research project.

AKBP 8.2 Tue 16:15 AKBP-H14

Determination of High-Pressure Rinsing on the Oxide-Layer Thickness and Oxygen-Concentration of Niobium Samples — •Rezvan Ghanbari[1,2], Marc Wenskat[1,2], Wolfgang Hillert[1,2], and Detlef Reschke[2] — [1]Institute of Experimental Physics, University of Hamburg, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron, Hamburg, Germany

This study is devoted to investigate the effect of High-Pressure Rinsing (HPR) on annealing procedures of Niobium (Nb) superconducting radio-frequency cavities. Recently, a so-called "mid-T bake" treatment has exhibited very high-quality factors for Nb cavities and developed models assume that the quality factor severely depends on the oxygen concentration in the near-surface of niobium. On the other hand, based on our observation, we realize that HPR may affect the thickness of oxide layers on the surface of niobium cavities, which is the dominant source of the oxygen diffusion during annealing. Thus, we have measured the oxide thicknesses, after various HPR durations, on the surface of Nb samples before and after applying mid-T bake treatment via Vertical Scanning Interferometer (VSI) and used Secondary Ion Mass Spectrometry (SIMS) to obtain the interstitial oxygen concentration after the annealing. In this way, we have investigated the importance of repeating and jetting high pressure water on the surface of niobium cavities to control oxide growth and we will show the results of this study.

AKBP 8.3 Tue 16:30 AKBP-H14

Surface preparation on niobium TESLA cavities for MESA at the HIM* — •Paul Plattner, Florian Hug, and Timo Stengler — Institut für Kernphysik , Johannes Gutenberg-Universität Mainz

The Mainz Energy-Recovering Superconducting Accelerator (MESA) will be a new recirculating accelerator, which can operate in an external beam mode and an energy recovering mode. In the ERL-mode the electrons cross an internal gas-target at MAGIX and give their kinetic energy into the Superconducting Radio Frequency (SRF) system back after experimental use. The MESA cryomodules are based on ELBE-type cryomodules, which contain two 9-cell TESLA/XFEL-type cavities. In the cryomodule the superconducting cavities are cooled down to 1.8 Kelvin with liquid helium. For maintenance of the cryomodules can be used the clean room infrastructure at the Helmholtz Institute Mainz (HIM). Currently a cryomodule from the ALICE ERL at Daresbury, UK is in the process of refurbishment. So, the current progress can be shown. A superconducting 3 GHz six-cell injector cavity for the S-DALINAC was used to demonstrate that the treatment of a high pressure rinse in the clean room infrastructure at HIM was successful. * This work has been supported by DFG through the PRISMA+ cluster of excellence EXC 2118/2019. The authors acknowledge the transfer of one cryomodule to Mainz by STFC Daresbury.

AKBP 8.4 Tue 16:45 AKBP-H14

Nb_3Sn thin film synthesis for SRF application by co-sputtering — •Nils Schäfer[1], Damian Günzing[2], Nail Karabas[1], Alexey Arzumanov[1], Deborah Motta-Meira[3], Katharina Ollefs[2], Márton Major[1], Heiko Wende[2], and Lambert Alff[1] — [1]Institute of Materials Science, Advanced Thin Film Technology, Technische Universität Darmstadt, Alarich-Weiss-Str. 2, 64287 Darmstadt, Germany. — [2]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), Universityof Duisburg-Essen, 47048 Duisburg, Germany. — [3]Argonne National Laboratory, 9700 South Cass Avenue, Lemont, IL, 60439 USA.

Thin film Nb_3Sn is a promising candidate to outperform bulk Nb in next generation particle accelerators. Bulk Nb is a well elaborated material for the superconducting radio frequency (SRF) application. However, this technology has reached its physical limits. Thin film Nb_3Sn is able to push the limits or save tremendous amounts of energy during operation. Unfortunately, the possible acceleration gradients of about 90 MV/m are not reached. Local deviations of the local stoichiometry and grain boundary segregations can be a possible explanation for this. To improve the local homogeneity and grain boundary conditions, a co-sputtering process is used. Extended X-ray absorption fine structure (EXAFS), X-ray absorption spectroscopy(XAS) mappings and X-ray diffraction (XRD) are used to show different grain boundary and phase conditions. Resistance versus field and resistance versus temperature measurements demonstrate the role of grain boundary and phase of the present Nb_3Sn thin films.

AKBP 8.5 Tue 17:00 AKBP-H14

Studies on the stability of different joining methods for permanent magnets — •Simon Gaebel, Carsten Kuhn, Stefan Gottschlich, Sebastian Knaack, Laura Brandenberg, Mario Strehlke, Johannes Bahrdt, Atoosa Meseck, Jürgen Bakos, and Stefan Grimmer — Helmholtz-Zentrum-Berlin

At HZB, research is being conducted into how the supply of synchrotron light from BESSY II can be improved to enable new experimental techniques and detectors at the beamlines. There, permanent magnets are playing an increasingly important role in the construction of new multibend achromat-based particle accelerators to deflect charged particles. Another central part of this research is the development of modern permanent magnet undulators. One of the challenging areas with these is the precise assembly and placement of permanent magnets. Due to increased requirements, such as reducing the period length of an undulator, new concepts for mounting the magnets have become necessary. Properties such as fatigue strength, shear strength and in certain contexts, e.g. with in-vacuum undulators, the vacuum resistance of the connection must be investigated. For this purpose, methods have been developed to investigate the load capacity of adhesive and solder joints. The presentation shows how these are applied and what the consequences are for the application.

AKBP 8.6 Tue 17:15 AKBP-H14

HTS undulators: status and test results of prototype coils for compact FELs — •Sebastian C. Richter[1,2], Amalia Ballarino[1], Daniel Schoerling[1], Axel Bernhard[2], and Anke-Susanne Müller[2,3] — [1]CERN - 1211 Geneva 23 - Switzerland — [2]LAS, KIT, Karlsruhe, Germany — [3]IBPT, KIT, Karlsruhe, Germany

Compact free electron lasers (FELs) require short period, high-field undulators in combination with shorter accelerator structures to produce coherent light up-to X-rays. Likewise, for the production of low emittance positron beams for future linear and circular lepton colliders, like CLIC or FCC-ee, high-field damping wigglers are required. Using high-temperature superconductors (HTS) in form of coated REBCO tape conductor allows reaching higher magnetic fields and larger operating margins as compared to low-temperature superconductors, like Nb-Ti or Nb3Sn. This contribution discusses the development work done on two superconducting undulator geometries (vertical racetrack and helical) with a period length of 13 mm, as well as the status of the prototype coils. Measurement results from powering tests in LN2 of multiple vertical racetrack coils are presented, compared and discussed.

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