AKBP 11: RF and SRF Research

Time: Wednesday 17:30–19:00 Location: CHE/0184

AKBP 11.1 Wed 17:30 CHE/0184

Thin Films On HOM Antennas To Push The Limits For Higher Beam Currents at MESA(*)(**) — •Paul Plattner, Florian Hug, and Timo Stengler — Institut für Kernphysik (KPH), Mainz, Deutschland

The Mainz Energy-Recovering Superconducting Accelerator (MESA), an energy-recovering (ER) LINAC, is currently under construction at the Institute for Nuclear physics at the Johannes Gutenberg-Universität Mainz, Germany. In the ER mode continues wave (CW) beam is accelerated from 5 MeV up to 105 MeV. The energy gain of the beam is provided through 2 enhanced ELBE-type cryomodules containing two 1.3 GHz 9-cell TESLA cavities each. By pushing the limits of the beam current up to 10 mA, a quench can occur at the HOM Antennas. This is caused by an extensive power deposition within the antenna. Calculations have shown that a power transfer of 1 W must be assumed. To prevent a quench of the HOM antennas by high beam currents without mayor modification of the design, it is necessary to find suitable materials. Nb3Sn and NbTiN can be applied as a coating to the antennas and have higher critical parameters than Nb which provides than a higher power limit. As a further approach to improve the power transfer by changing to material from the antenna to OFHC Copper. The limit of the coated antennas will be tested with the cavities of a cryomodule from the decommissioned ALICE from STFC Daresbury. (*)The authors acknowledge the transfer of one cryomodule to Mainz by the STFC Daresbury. (**)The work received funding by BMBF through 05H21UMRB1.

AKBP 11.2 Wed 17:45 CHE/0184

Nb3Sn Co-Sputtering for Interlayer-Free High Performance Copper SRF Cavities — •Nils Schäfer, Carl Jung, Matthias Mahr, Carl Jung, Christian Dietz, Sebastian Bruns, Márton Major, and Lambert Alf — Technische Universitaet Darmstadt (TU Darmstadt) Institute of Materials Science FB 11

Nb3Sn thin film coatings are a promising candidate to replace bulk Nb to increase performance and energy efficiency of SRF cavities. Replacing niobium by Nb3Sn coated copper would not only reduce material*s cost, but would also allow optimal heat removal for higher cryogenic efficiency. The challenge is the detrimental interdiffusion of Cu into Nb3Sn at the typically high deposition temperatures conventionally used for Nb3Sn synthesis. We have recently introduced a novel kinetically driven low-temperature co- sputtering process that overcomes the copper diffusion challenge. In this break-through process, even a diffusion barrier layer is not needed, because the Cu diffusion is minimized to an extent where the superconducting properties of Nb3Sn are not negatively affected. Magnetization versus temperature measurements demonstrate the good shielding performance in parallel orientation of the Nb3Sn thin films on the copper substrate. Mechanical nanondentation and scratch tests demonstrate that even after thermal cycling of the sample, the adhesion properties the Nb3Sn thin film coatings are excellent. Work supported by the German Federal Ministry for Education and Research (BMBF) through grant 05H21RDRB1 and the German Research Foundation (DFG) via the AccelencE Research Training Group (GRK 2128).

AKBP 11.3 Wed 18:00 CHE/0184

low-temperature magnetron co-sputtering of Nb3Sn for SRF application — •Hamidreza Ghasemi[1], Nils Schäfer[2], Márton Major[3], Alexey Arzumanov[4], and Lambert Alff[5] — [1]Technical University of Darmstadt, Darmstadt, Germany — [2]Technical University of Darmstadt, Darmstadt, Germany — [3]Technical University of Darmstadt, Darmstadt, Germany — [4]Technical University of Darmstadt, Darmstadt, Germany — [5]Technical University of Darmstadt, Darmstadt, Germany

For the last decades, bulk niobium has been the material of choice for superconducting RF cavity applications. Nb3Sn thin films are another candidate for SRF cavities. The benefits of using Nb3Sn instead of Nb would be higher critical temperature and higher critical magnetic field, leading to significant cryogenics cost reduction. The Tc is maximal for about 25% tin content and decreases significantly for less than 23at%. Therefore, the big problem of Nb3Sn is the synthesis of the material. The most promising fabrication method of Nb3Sn is the tin vapor diffusion method. Control of the small stoichiometry range and Sn gradients are the challenges of this method. In single-target sputtering and multi-layer sputtering we have to deal with tin loss and surface segregation(due to high annealing temperature). Co-sputtering allows the tuning of the kinetic energy of both elements independently and offers high-performance thin films at low temperatures. This work presents recent results of Nb3Sn synthesis on Copper substrate by magnetron co-sputtering. This work supported by the German Federal Ministry for Education and Research (BMBF) through grant 05H21RDRB1.

AKBP 11.4 Wed 18:15 CHE/0184

Development of a system for the rapid RF characterization of superconducting samples — •Sebastian Keckert[1], Felix Kramer[1], Oliver Kugeler[1], and Jens Knobloch[1,2] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin — [2]Universität Siegen, Fachbereich Physik, Siegen

Niobium is currently the material of choice to produce superconducting radio frequency (SRF) cavities for applications in particle accelerators. These cavities are operated at temperatures of 2 K or lower to ensure manageable dynamic losses at high accelerating gradients. Presently, alternative materials to niobium and composite structures relying on thin film coatings are investigated in various R&D projects. Applied to SRF cavities such an advanced material or coating will allow performances beyond the fundamental limits of niobium and eventually operation temperatures of 4.2 K or higher. The development of such coatings requires RF characterization of superconducting samples and especially measurements of the RF surface resistance.

This contribution discusses the development and first commissioning results of a Rapid Superconductor Test Apparatus (RaSTA), a compact sample test cavity. In contrast to other test setups, RaSTA allows to distinguish BCS and residual resistance with high resolution but with far shorter turnaround times, enabling systematic studies of multiple samples and thus iterative optimization of materials production techniques.

AKBP 11.5 Wed 18:30 CHE/0184

Gobau-Line Measurements for In-Vacuum Undulators — •Paul Volz — Helmholtz-Zentrum Berlin für Materialien und Energie — Johannes Gutenberg-Universität Mainz

The in-vacuum elliptical undulator, IVUE32, is being developed at Helmholtz-Zentrum Berlin. The 2.5 m long device with a period length of 3.2 cm and a minimum gap of about 7 mm is to be installed in the BESSY II storage ring. The proximity of the undulator structure to the electron beam makes the device susceptible to wakefield effects which can influence beam stability. A complete understanding of its impedance characteristics is required prior to installation and operation. To understand and measure the IVU's impedance characteristics a Goubau-Line test stand is being designed. A Goubau-line is a single wire transmission line for high frequency surface waves with a transverse electric field resembling that of a charged particle beam out to a certain radial distance. First measurements from a prototype test stand, designed to measure IVUE32-components will be presented.

AKBP 11.6 Wed 18:45 CHE/0184

Influence of High-Pressure Rinsing on the Oxide-Layer Thickness and Oxygen-Concentration of Niobium Samples — •Rezvan Ghanbari[1], Marc Wenskat[1], Mona Kohantorabi[2], Heshmat Noei[2], Arti Dangwal Pandey[2], Detlef Reschke[2], and Wolfgang Hillert[1] for the University of Hamburg-Collaboration — [1]Institute of experimental physics, University of Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Germany

This study is devoted to investigate the effect of High Pressure Rinsing (HPR) on the outcome of 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. The complementary 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 affects 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 of Nb samples before and after applying mid-T bake treatment via X-ray Photoelectron Spectroscopy (XPS) and used Sec-

ondary Ion Mass Spectrometry (SIMS) to obtain the interstitial oxygen concentration after the annealing. The results of this investigation will be presented and discussed in the context of theoretical models.