ACCELERATOR SEMINAR

"Surface Impedance of Superconducting Radio Frequency (SRF) Materials"

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Superconducting radio frequency (SRF) technology is widely adopted in particle accelerators. There remain many open questions, however, in developing a systematic understanding of the fundamental behavior of SRF materials, including niobium treated in different ways and various other bulk/thin film materials that are fabricated with different methods under assorted conditions. A facility that can measure the SRF properties of small samples in a range of 2~40 K temperature is needed in order to fully answer these questions. The Jefferson Lab surface impedance characterization (SIC) system has been designed to attempt to meet this requirement. It consists of a sapphire-loaded cylindrical Nb TE_{011} cavity at 7.4 GHz with a 50 mm diameter flat sample placed on a non-contacting end plate and uses a calorimetric technique to measure the radio frequency (RF) induced heat on the sample. Driving the resonance to a known field on this surface enables one to derive the surface resistance of a relatively small localized area. Tests with polycrystalline and large grain bulk Nb samples have been done at <15 mT magnetic field. Based on BCS surface impedance, least-squares fittings have been done using SuperFit2.0, a code developed by G. Ciovati and the author.

Microstructure analyses and SRF measurements of large scale epitaxial MgB2 films have been reported. MgB2 films on 5 cm dia. sapphire disks were fabricated by a Hybrid Physical Chemical Vapor Deposition (HPCVD) technique. The electron-beam backscattering diffraction (EBSD) results suggest that the film is a single crystal complying with a MgB2(0001)//Al2O3(0001) epitaxial relationship. The SRF properties of different film thicknesses (200 nm and 350 nm) were evaluated using SIC system under different temperatures and applied fields at 7.4 GHz. A surface resistance of 9 2 μΩ has been observed at 2.2 K.

Based on BCS theory with moving Cooper pairs, the electron states distribution at 0K and the probability of electron occupation with finite temperature have been derived and applied to anomalous skin effect theory to obtain the surface impedance of a superconductor with moving Cooper pairs. We present the numerical results for Nb.

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11:00 a.m.
CEBAF Center, Room F326/327

Jefferson Lab

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