Seminar Talk

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3:00 p.m. KH 224

Title:
Superconducting Thin Films.

Abstract:
Superconducting (SC) niobium (Nb) thin films provide an attractive solution to accelerator cavity manufacturability, but so far have been deficient in their radio-frequency (RF) performance. Physical vapor deposition (PVD) techniques, such as sputtering, have been largely favored, but have nearly always resulted in finite surface impedance. Excessive grain boundaries, imposed by fibrous crystal growth, limit the electron mean-free path, resulting in lower residual resistance ratios, (RRR) than bulk Nb. Many methods have been devised to control the fibrous growth, as well as post-growth processing involving extensive surface polishing. The use of cold substrates to control surface energies during nucleation leads to an alternative method for film growth, whereby an amorphous film is grown beyond the thickness during which grain competition is completed. Localized, thermally-induced re-crystallization of the film surface results in equi-axed, large-grain crystalline structure over several penetration depths, resembling bulk Nb. In addition, recent work by Thompson and Floro, involving thin films of Ag on Ni substrates, describes a mechanism for abnormal grain growth in thin films, whereby the interface energies and initial film thicknesses are manipulated to favor radial (2-D) grain growth. Extending this technique to Nb, the resulting large-grain Nb (110) film provides a template for homo-epitaxial deposition, in order to create thicker bulk-like SC films. In both cases, energetic condensation via magnetron sputtering onto a LN2-cooled (77 K) substrate creates the initial Nb film, possessing amorphous grain structure, and exhibiting internal energy far from equilibrium. This "frozen-in" potential energy is available to drive the 2-D grain growth. Controlled heating for surface re-crystallization is provided by a pulsed UV HIPPO laser, raster-scanned over the film surface. Also, since the surface processing is performed in the vacuum chamber, any chance for native oxide layer buildup is eliminated.

Biography:
After his formative years in Traverse City, Michigan, Mr. Musson attended Michigan State University, graduating in 1989 with a BS in Physics. Subsequently, he relocated to Blacksburg,

Virginia, where he joined the Satellite Communications Group at VPI&SU, eventually completing his MSEE degree in 1994, with work primarily involving radio engineering, satellite communications, and propagation experiments (Thesis: "Man-Made Impulsive Noise on the 137 MHz VHF LEOSat Channel").

After 13 years at the Thomas Jefferson National Accelerator Facility, in Newport News, Virginia, he returned to ODU to pursue his PhD in superconductive thin film research, under Dr. Elsayed-Ali and Dr. Larry Phillips (adjunct).

While not buried in the laboratory, Mr. Musson pursues his strong interests in Amateur Radio, sailing, Appalachian banjo, ice hockey, fly-fishing, and raising 3 kids with his wonderful wife.