Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Electron energy loss spectroscopy study of superconducting Nb and its native oxides RUNZHE TAO, R. TODOROVIC, J. LIU, R. MEYER, A. ARNOLD, University of Illinois at Chicago, W. WALKOSZ, P. ZAPOL, ANL, A. ROMANENKO, L. COOLEY, FNAL, ROBERT KLIE, University of Illinois at Chicago — Niobium has attracted increasing attention in recent years due to its usage in superconducting RF-cavities in next generation particle accelerators. In particular, the possible role of oxidation or the presence of oxygen vacancies on the superconducting properties of niobium metals used in superconducting RF cavities has been the focus on many recent studies. Here, we present a series of electron energy-loss spectroscopy (EELS) studies on niobium (Nb) and its oxides (NbO, NbO_2, Nb_2O_5) to develop a reliable method for quantifying the oxidation state in mixed niobium oxide thin films. Our approach utilizes a combination of transmission electron microscopy and EELS experiments with density functional theory calculations to distinguish between metallic niobium and the different niobium oxides. Based on these observed changes in the core-loss edges, we propose a linear relationship that correlates the peak positions in the Nb M- and O K-edges with the Nb valence state. The methods developed in this paper will then be applied to ultrathin niobium oxide films to examine the effects of low-temperature baking on the films' oxidation states. In addition to oxides, Niobium hydrides are considered as one of the main reasons for Q-decrease under high field. The different phases of Nb hydride can be identified directly using electron diffraction and EELS, which allows for the local hydrogen concentration to be examined at room temperature as well as 95 K.

Runzhe Tao
University of Illinois at Chicago

Date submitted: 15 Nov 2011 Electronic form version 1.4