

## Parametric Study of the Thermal Conductivity of Superconducting Niobium

Saravan K. Chandrasekaran, James V. Beck and Neil T. Wright<sup>C, S</sup>

*Department of Mechanical Engineering, Michigan State University, East Lansing, MI, U.S.A.*

High-purity niobium is used to construct the superconducting radio-frequency (SRF) cavities that accelerate charged particles for high-energy physics and biomedical applications. These cavities operate at temperatures of approximately 2 K, at which the thermal conductivity may be about three-fold greater than at 4 K due to the so-called phonon peak. The processing history of the niobium, and thus the crystal structure and imperfection density, determine the existence of this phonon peak. Reduced heat transfer degrades the accelerating gradient of the SRF cavities by restricting the magnetic field to significantly less than its theoretical maximum. Thus, there is a need for improved understanding of thermal conductivity within the range of operating temperatures, and the material processing parameters that influence the thermal response. The model of niobium thermal conductivity proposed by Koechlin and Bonin (1996) is examined as a baseline. The scaled sensitivity coefficients of its parameters are calculated and indicate that the parameter related to momentum exchange electron with lattice conductance has no significance in the thermal conductivity at these temperatures and cannot be estimated using data in this regime. The remaining parameters are estimated from measurements using the Box – Kanemasu interpolation method. The relationship of these parameters to the crystallographic state of the experimental specimens is discussed.

Reference: Koechlin, F. and Bonin B., 1996, “Parametrization of the niobium thermal conductivity in the superconducting state,” *Superconductivity Science and Technology*, v. 9, pp. 453–460.