Prompt Gamma Neutron Activation Analysis of Niobium for Characterization of Light Interstitials

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Abstract

High purity niobium metal is used in the construction of superconducting radio frequency (SRF) cavities in superconducting particle accelerators, such as the Large Hadron Collider (LHC) at CERN or the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory. The usual method for characterizing the impurities in this niobium, the residual resistivity ratio (RRR) technique, can provide information relating to the superconducting quality of the material, and thus, a measure of the impurity content that is not specific to chemical elements. To improve the material quality further, another method, Prompt Gamma Neutron Activation Analysis (PGNAA), must be used to specifically identify the elemental impurities at parts per million (ppm) levels. This study investigates the use of PGNAA for the application of high purity niobium metal, through the use of the PGNAA facility at the Oregon State University TRIGA ® Reactor (OSTR). Two standard samples were used to determine the analytical sensitivity of the facility, and five “unknown” samples were analyzed to determine the ability of the PGNAA technique to identify impurities known as light interstitials (H, C, N, and O). The PGNAA technique shows promise in this application, with results on the order of magnitude of current chemical analysis techniques.

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