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M2Po2C-05 [41]: RRR Estimation of Niobium using inflection point on the frequency response of a planar inductive sensor

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A clear indicator of purity of niobium (Nb) used for fabricating Superconducting Radio Frequency (SRF) cavities is the Residual Resistivity Ratio (RRR) of the bulk Nb. Usual methods of determining the RRR is by Four-probe resistance measurement techniques. This process is destructive in nature and provides an average value of the RRR of the sample that is being used. It has already been shown in other literatures that the RRR of the Nb changes as the RF cavity moves through various fabrication processes. In order to characterize the RF cavity through different stages of fabrication, a local, non-contact method for measuring RRR is required. This paper discusses one such non-destructive method for RRR estimation using planar inductive sensors.

Whenever a conductor is brought in the presence of an inductive sensor which is excited by an AC signal, the impedance associated with the sensing coil varies. This variation is a function of eddy current penetration depth (δ), the electrical conductivity (σ), the frequency of excitation (f) and the series inductance term (Ls) of the impedance of the sensing coil. The frequency response of the Ls term of the sensor will have an inflection point whenever the eddy current penetration depth becomes equal to the thickness of the sample. By determining the inflection point on the Ls-F graph close to the critical temperature (Tc) and at room temperature (Tr), the RRR can be estimated.

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