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M2Po3C-01: Investigating the microstructure of cold-worked and annealed SRF Niobium using Shannon Entropy

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Residual trapped magnetic flux suppresses the quality factor of SRF Nb cavities and thus microstructural features that can trap flux are of particular interest for developing higher performance cavities. We have been investigating tools to help quantify the microstructure of Nb to make it easier to compare microstructures resulting from different cavity processing routes. EBSD mapping is the preferred tool for quantifying crystallographic information in microstructural cross-sections. It can produce reliable grain size data but is expensive and slow if large areas need to be quantified. Backscattered electron imaging by SEM is an economical method of analyzing large areas and is more widely available than EBSD but cold-worked microstructures in Nb have high degrees of lattice distortion making them challenging for standard image analysis techniques. We are investigating the use of Shannon Entropy as a method of quantifying SEM-BSE images of Nb. Claude Shannon theories of information are used in a wide range of interdisciplinary sciences, and using Shannon Entropy of an image, we can extract quantifiable information from SEM-BSE of Niobium using BSE images. We report on 1) the entropy of heat-treated Nb microstructures ranging from as-received (cold-worked) to annealed at 900℃ for 3 hours, 2) the parameters used in the calculation to find the most effective values for adjustable parameters, and 3) a comparison to EBSD images for determination of the recrystallized fraction to see if Shannon Entropy maps can be used as an effective alternative.

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