Industrial generator components experience high stresses and electrical fields during their service life. Material integrity is key in guaranteeing component performance. CuNi2SiZr, used as rotor wedges in generators, serve to maintain rotor slot content in place while experiencing high centrifugal stresses and low cycle fatigue during start and stop at elevated temperature. The quality and integrity of this material in service can be directly related to its microstructure, which is determined by the processing procedures of the wedges.

In this study, the microstructure development in this material is evaluated to eliminate grain boundary defects by optimizing processing parameters, determining the best temperature/time combination for precipitation hardening, and determining cold work effect on aging parameters. Two chemistries containing Nickel-to-Silicon ratios of 3.2 and 3.8 were selected for analysis. Cast samples were hot extruded, cold worked, and precipitation hardened. Parameters were varied at each processing step. Five different levels of cold work (4, 5, 7, 10 and 13%) were evaluated using 5 different aging temperatures (450, 460, 470, 490 and 500°C). Each processing parameters’ effect on microstructure and subsequently on hardness, conductivity, and tensile strength was recorded to assess material performance and identify grain boundary defects origination.

Finding of this study identified observed grain boundary defects, using Transmission Electron Analysis, as voids/micro-tears. These defects on grain boundary are detrimental to low cycle fatigue, creep rupture and tensile strength properties and important aspects of the material performance. Grain boundary defects were observed at all levels of cold work, however, origination of defects was only observed in grain sizes larger than 50μm. The strengthening phases for the CuNi2Si+Zr alloy system were identified as Ni2Si and Cr3Si. The Nickel-to-Silicon ratio had an evident effect on the electrical conductivity of the material. However, aging benefits were not clearly established between the two Nickel-to-Silicon ratios.

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The public is welcome to attend.