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M3Or2A-01: [Invited] The effects of monotonic and cyclic plastic strain at 4.2K on the electrical resistivity of bulk Al High Purity Aluminum"

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The use of high purity aluminum (HPAL) for low temperature electrical conductor applications has been a subject of study for more than 50 years. The attractions include low density, very low electrical resistivity material at reasonable cost, and very low magneto-resistivity, all compared to those metrics for oxygen free high conductivity copper (OFHC Cu). The chief drawbacks to using Al are very low mechanical strength and difficulties in making electrical joints. Cu is chosen over Al for low temperature cryo-conductor or composite superconductor stabilizer applications primarily because of its mechanical and electrical contact and joining advantages. Because of the increased interest in low temperature conductor materials for aerospace and space applications in recent years, where weight is important, the possible use of HPAL for cryoconductors has enjoyed a comeback. An important aspect of a low resistivity conductor is that it retains its low resistivity during fabrication and use. Plastic strain to HPAL will cause an increase in resistivity, so it is important to understand the relationship between these variables. The work reported will discuss how monotonic and cyclic plastic strain at cryogenic temperatures influence the electrical resistivity of HPAL. This work involved cryogenic tensile and cyclic plastic strain experiments on centimeter diameter bars of 4N to 5N5 Al. Resistivity measurements were taken by a contactless method during the plastic strain testing. An interesting result of cryogenic cyclic plastic strain on HPAL is that the material becomes fully hard after several hundred strain cycles.

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