



Contribution ID: 449

Type: **Contributed Oral**

## **M3Or2A-02: Developing practical Cryogenic high purity aluminum (HPAL) conductor to enable high speed power density motors and generators.**

*Wednesday 21 May 2025 11:45 (15 minutes)*

Cryogenic high purity aluminum (HPAL) conductor was originally developed and reported at the Air Force Research Laboratories in the 1980s. The basic idea was to exploit the potential to fabricate very high purity aluminum (5 or 6 'nines' Al), which could achieve exceedingly low resistivity values in the 20 K and below temperature range. By using very high purity Al, the resistivity ratios (RRR) of 2000 or more became possible at 20 K. Since typical RRR is 100 for standard oxygen free, high conductivity (101) Cu, this leads to a resistivity potentially 20 X lower than cryogenic Cu, or > 2000 X times lower than ambient temperature Cu. HPAL transports high current densities with minimal Joule heating. However, it's mechanical softness requires the addition of a strengthening component. Efforts to strengthen the material utilizing an Al-Fe-Ce sheath were successful, but this sheath had a moderately low resistivity that showed a significant anomalous magnetoresistance due to Hall effect around the sheath. Hyper Tech have successfully developed a multi-filamentary HPAL conductor which employs matrices and sheaths with higher resistivity to suppress the anomalous magnetoresistance counterpart. Such conductors would be similar to commercially available Cu Litz cables but with the advantage of low resistivity at low temperature of HPAL. We also made it into a cable, and wound it to form coils. In this paper, we will present the progress of making long length HPAL conductor and its applications on high frequency stator and generators in Hyper Tech.

**Authors:** KOVACS, Chris (Hyper Tech Research Inc.); Mr KWON, Jin; RINDFLEISCH, Matt (Hyper Tech Research); SUMPTION, Mike; TOMSIC, Mike; Dr PENG, Xuan; Mr GUO, Yang (The Ohio State University)

**Presenter:** Dr PENG, Xuan

**Session Classification:** M3Or2A - High Purity Aluminum for Low Temperature Conductor Applications