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Microanalysis of Glidcop® conductor, an alumina particle dispersion strengthened copper, for ultrahigh field pulsed magnet applications

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Glidcop® is an alumina-particle dispersion-strengthened copper that has good properties combing high mechanical strength and high electrical conductivity. Therefore it has been used as a conductor for ultrahigh field pulsed magnets by the National High Magnetic Field Laboratory (NHMFL). Glidcop® is manufactured by powder metallurgy where powder of Cu-Al alloy and oxidant powder are mixed and heat treated. The heat treatment results in fine alumina particles in copper matrix. Glidcop® is commercially available with three grades, AL15, AL25, and AL60 with increasing Al2O3 content and highest strength.
There are evidences that the alumina particle size and density distributions determine its strength and ductility, which in turn determines its ability of cold forming such as wire drawing. If particle size is large or not evenly distributed, serious issue such as internal cracks or so-called 'chevron'cracks could be developed in the wire drawing process. The chevron crack causes wire breakage and, as a result, a very poor production yield. If undetected, these internal cracks may cause premature magnet failure.
In this work, we study the microstructure of Glidcop® materials by electron microscopy and correlate the microstructure with its performance. We identified the aluminum oxide particles to be □-Al2O3. We found significant non-uniform distribution of these particles. In addition, the particle size varies widely from a few nanometers to a few microns. We will discuss the implication of these findings.

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