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Effects of Cooling Rate on 6.5% Silicon Steel Ordering

Abstract: Increasing Si content improves magnetic and electrical properties of electrical steel, with 6.5% Si as the optimum. Unfortunately, when Si content approaches 5.7%, the Fe-Si alloy becomes brittle. At 6.5%, the steel conventional cold rolling process is no longer applicable. The heterogeneous formation of B2 and $D0_3$ ordered phases is responsible for the embrittlement. The formation of these ordered phases can be impeded by rapid cooling. However, only the cooling rates of water and brine water were investigated. A comprehensive study of the effect of rapid cooling rate on the formation of the ordered phases was carried out by varying wheel speed and melt-injection rate. Thermal imaging employed to measure cooling rates while microstructures of the obtained ribbons are characterized using X-ray diffraction and TEM. The electrical, magnetic and mechanical properties are characterized using 4-pt probe, VSM, and macro-indentation methods. The relations between physical properties and ordered phases are established.

Biography: Dr. Cui obtained his PhD from the University of Minnesota in 2002, and postdoc-ed at the University of Maryland for 2 years. In 2005, Dr. Cui joined GE Global Research Center and started working on various energy materials. In 2010, he moved to Pacific North-west National Lab and focused his research on magnetic materials. In 2015, Dr. Cui's joined Iowa State University as Associate Professor and hold a Senior Scientist position at Ames Laboratory. Dr. Cui's research area focuses on magnetic materials, including both hard magnetic materials such as Sm-Co based rare earth magnet and rare earth free MnBi based magnet; and soft magnetic materials such as high silicon electrical steels. In addition, Dr. Cui works on elastocalroic materials and serves as deputy director for CaloriCool, a US DOE Energy Materials Network Consortium. Dr. Cui published over 40 papers and hold 7 patents.