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Development of Magnetic Materials Based on the Ordered $Fe_{50}Ni_{50}$ Phase: Methodologies and Results[1] ERIC POIRIER, MEDA Engineering and Technical Services, MISLE M. TESSEMA, Optimal CAE, MARTIN S. MEYER, FREDERICK E. PINKERTON, General Motors Global RD — The $L1_0$ FeNi structure known as tetrataenite, usually found in meteorites, is reported to possess significant magnetocrystalline anisotropy suitable for hard magnetic properties. As part of the ongoing Advanced Research Project Agency-Energy project on FeNi-based magnets, melt-spinning was used to synthesize new FeNi precursors. The melt-spinning conditions were established in terms of wheel speed, ejection pressure, and atmosphere composition and pressure. The as-spun ribbons have a cubic crystal structure with a=3.584 $\pm$ 0.002 Å, and (100) preferred grain orientation perpendicular to the ribbon. They also behave like soft magnetic materials, with coercitivities below 0.3 kOe. DSC response curves were essentially featureless, except for a thermal signature at about 515 °C associated with the Curie temperature. In contrast, melt-spun FeNi ribbons that were subsequently ball-milled and annealed exhibited a more complex thermal behavior compared to the as-spun ribbons with a weak endotherm in the 300-350 °C range followed by an exotherm at higher temperatures. These results are discussed in the context of a search for an order-disorder phase transition associated with the $L1_0$ phase, and preferred properties for permanent magnet applications. Although $L1_0$ phase formation was not observed at this point, the techniques established for processing FeNi will be further studied on modified FeNi alloys as a promising route to obtain the $L1_0$ phase.

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