SYNTHESIS BY RAPID SOLIDIFICATION AND SPARKPLASMA SINTERING OF SINGLE-PHASE $DYNI_5$

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Theoretical and experimental studies show that the binary compounds RNi_5,with R = Tb, Dy, Ho, and Er, are attractive magnetic materials for magnetic refrigerationin the temperature range of H_2 liquefaction. For such a purpose, highsaturation magnetization values and moderate-to-low values of specific heat aretwo of their favorable characteristics. Furthermore, their anisotropicmagnetization behavior could produce a high-rotating magnetocaloric effect. Inthis work, we report the synthesis and characterization of partially textured melt-spunribbons obtained by ultrafast solidification using the melt-spinning techniqueand their consolidation into high-density sintered bodies by applying the sparkplasma sintering (SPS) technique. Particular attention was paid to replicating the partial anisotropic magnetization properties of the melt-spun ribbons in the sintered sample. The melt-spun ribbons were synthesized at a linear copperwheel speed of 20 ms^{-1} from a solid ingot obtained by arc melting(both processes were carried out under a high-purity Ar atmosphere). The densificationprocess was performed in about 6.7 minutes. The elemental chemical compositionand hexagonal crystal structure of the $CaCu_5$ type of $DyNi_5$determined by EDS analysis and X-ray diffraction were reproduced in thesintered sample, which had a relative density of 95.5%. The magnetizationmeasurements also show that the magnetic and anisotropic properties of theribbons were reproduced in the sintered sample. The Curie temperature (T_C)of the $DyNi_5$ phase was ~ 11.8 K, while at 2 K and 5 T the saturationmagnetization M_S between the pressing direction (M_S= 100 Am^2kg^{-1}) and the perpendicular plane (M_S= 67 Am^2kg^{-1}) showed a difference of 23 Am^2kg^{-1}.For a magnetic field variation of 2 and 5 T, the maximum values of magneticentropy change $|\Delta S_M|^{max}$along the pressing direction were 10 and 16 $Jkg^{-1}K^{-1}$,respectively. Furthermore, a rotational magnetic entropy change $|^{max}$of 3.2 $Jkg^{-1}K^{-1}$ was determined between the pressing and perpendiculardirections.

Keywords: DyNi5 intermetallic compound, melt-spun ribbons, conventional and rotational magnetocaloric effect

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