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Experimental study and thermodynamic assessment of the dysprosium-hydrogen binary system

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Abstract

The dysprosium-hydrogen (Dy-H) binary system in the full range of H/Dy=0 to 3.0 is investigated by accurate pressure composition isotherm (PCI) measurement, including a PCI measurement of the β -DyH₂/ γ -DyH₃ transition for the first time. The Dy/ β -DyH₂ biphasic region shows well defined plateaus in the range of H/Dy=0.41 to 1.65 at 650°C and gradually shrinks to 0.54 to 1.23 at 900°C, with transition enthalpy of 213.1 \pm 2.8 kJ/mol H₂. The β -DyH₂/ γ -DyH₃ biphasic region also shows well defined plateaus from 250°C to 325°C, but with much narrower composition region of H/Dy from 2.3 to 2.9. The transition enthalpy is 79.3 \pm 2.2 kJ/mol H₂. The phase diagram and thermodynamic parameters are calculated with the CALPHAD method using the measured PCI data. The obtained results are in very good agreement with our experimental data and the published data reported in literature. The results provide more comprehensive and quantitative insights into the key thermodynamic properties of the Dy-H system.

Keywords: Rare earth hydrides, Pressure composition isotherm, Phase diagram, Thermodynamics

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