

the pairs makes the structure of the saturated solution, i.e. RGa_4 , very similar to the structure of RGa_6 . The latter may be obtained by the replacement of the remaining $1/3$ R atoms in the f: $1/2, 1/2, 0$ of Pmm by the Ga-pairs. The replacement of the remaining R-atoms in RGa_6 by the Ga-pair leads to the formation of a second net of hexagons, characterizing pure Ga.

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ADAPTATION OF NEW TECHNIQUES TO STUDY SURFACE AND BULK PROPERTIES OF H-METAL SYSTEMS

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Three newly developed techniques were applied to the research of hydrogen-metal systems. One of these methods (time-of-flight analysis of direct recoils, TOF-DR) permits the direct identification of surface hydrogen and its isotopes (as well as other surface atoms). It provides valuable information on surface composition, surface chemistry and surface structure thereby elucidating hydrogen-surface processes which so far were obscure. The second technique (nuclear resonant scattering of gamma rays) may be used for deducing Debye temperatures of certain elemental components in any chemical compound in general and in metal hydrides in particular. The main advantages of this technique are: a) it may be regarded as providing a direct measurement of the atomic velocities, including the zero-point vibrations; b) it isolates the contribution of certain components to the Debye temperature of the whole compound. The third technique (thermal desorption spectroscopy, TDS) can contribute substantially to the understanding of bulk and surface behavior, equilibrium properties and desorption kinetics of hydrogen in metals.

PRESSURE-INDUCED EFFECTS AND PHASE RELATIONS IN Mg_2NiH_4

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The low-temperature ($<210^\circ\text{C}$) crystallographic structure,

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electrical conductivity and thermal stability of Mg_2NiH_4 powders compacted under isostatic pressures of up to 10 kbar were studied. A comparison was made with the corresponding properties of the non-compressed material. It was concluded that under stress-free hydriding conditions and at temperatures below $210^{\circ}C$, a two-phase hydride mixture is formed. Each of the hydride particles consists of an inner core composed of a hydrogen-deficient monoclinic phase, coated with a layer of a stoichiometric orthorhombic phase. The monoclinic phase has a metallic-like electrical conductivity while the orthorhombic phase is an insulator. High compaction pressures cause the transformation of the orthorhombic to the monoclinic structure, thereby resulting in a pressure-induced insulator-to-conductor transition. Reduced decomposition temperatures are obtained for the compressed hydrides. This reduction is attributed to kinetic factors rather than to a reduced thermodynamic stability.

FACTORS AFFECTING THE HYDRIDING PROPERTIES OF $Ca_xEu_{1-x}Ni_5$ ($0 < x < 1$) COMPOUNDS

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Electron spectroscopy studies (AES, XPS and UPS) were performed on the Haucke compounds $Ca_xEu_{1-x}Ni_5$ ($x = 0, 0.17$ and 0.75). These compounds display widely differing hydriding characteristics, regarding both activation kinetics and equilibrium properties, for the different x values. The analysis of the valence band structures of these compounds reveals a striking similarity. Hence, the differing equilibrium properties are probably not dominated by electronic contributions. Interstitial hole size calculations indicate a slight increase of the hole radii with an increase in the Ca content of the compound, which may account for the trend in the stabilities of the corresponding hydrides. Surface analysis of the argon-handled as-inserted samples points to the presence of very thin (i.e. a few atomic layers) passivation films on the compounds. The different reactivities of the as-inserted compounds towards hydrogen (during the first activation cycle) are attributed to the different permeability characteristics of these oxidized overlayers.