

FORMATION AND DECOMPOSITION OF METAL HYDRIDES TREATED AS COHERENT AND INCOHERENT PHENOMENA

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Introduction

So far phase transitions in Me-H systems were mostly treated similarly as in fluids. It means, that the elastic energy, which is acting in coherent phase transitions was neglected. This additional energy acts only in the formation process, differently to the decomposition, in which the hydride and the metal phase – formed after the decomposition – are decoupled. The coherence of the formation process is clearly illustrated on the figure below.

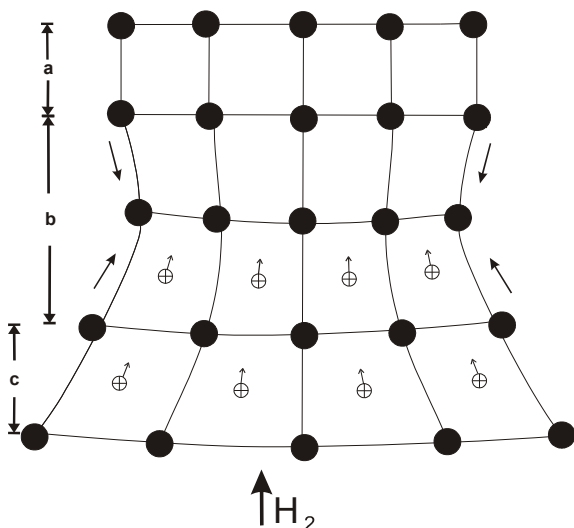


Fig.1. Schematic graph of lattice changes during the hydride formation as a coherent process.

One can distinguish 3 different regions: the upper part (a), corresponding to the virgin metal, the lower part (c) – which illustrates the lattice in a hydride phase and intermediate zone (b), where the stress, caused by the hydride front arises. The “stress-creating” intermediate region will

migrate through the bulk α - phase, transforming it continuously into the β - phase. The coherent way of hydride formation is stated as the reason of the penetration depth limitation [1], discovered experimentally in nickel [2], as well as in Pd-Ni alloys [3].

Contrary to the formation process described, the decomposition of the hydrides proceeds incoherently, that means by discontinuous release of hydrogen under stressless conditions. The energetic difference between the coherent formation and the incoherent decomposition processes is the very reason for the differences between formation and decomposition pressures (hysteresis) observed [4].

It is claimed, that the desorption plateau represents the true thermodynamic equilibrium.

References

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