"Uphill" hydrogen diffusion effects of hydrogen interstitial strain gradients in palladium and palladium alloys

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Abstract

Utilisations of palladium alloys as hydrogen purification membranes provide technological background circumstances for a phenomenon known as "Uphill Hydrogen Diffusion Effects". The membranes utilised have been in the form of both tubes and sheets. In experimental procedures, permeating hydrogen is introduced from external surfaces and hydrogen permeation through membrane walls, is monitored by changes in either the hydrogen pressure within the tubes or the electrode potentials of their opposite internal surfaces. For clear observations of Uphill Effects, both membrane surfaces have been coated with catalytically active palladium black. When membrane walls initially contain hydrogen, further increases of hydrogen contents at their outer external surfaces could produce initial reductions of hydrogen pressure or equivalent pressures calculated from values of electrode potentials measured at opposite internal surfaces before the expected onset of gradually increasing pressure. Such Uphill Effects could be satisfactorily explained in terms of overall expansions of the interstitial sites by hydrogen having been responsible for corresponding strain gradients that extended from outer to inner surfaces and produced complementary Grosky Effect hydrogen transfers. Studies of Uphill Effects have now been extended to include measurements with various experimental arrangements and with differently activated surfaces of membranes of palladium, nickel and ranges of compositions of alloys of palladium with platinum, silver and cerium.

Indexed keywords

Engineering controlled terms: Black coatings; Diffusion in solids; Gas permeable membranes; Hydrogen; Mechanical permeability; Palladium; Pressure effects; Purification

Engineering uncontrolled terms: Grosky effect; Interstitial strain gradients; Uphill hydrogen diffusion effects

Engineering main heading: Palladium alloys