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Hydride formation during cathodicpolarization of Tiâ€”I. Effect of current density on kinetics of growth and composition of hydride

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Abstract

The kinetics of the absorption of hydrogen in Ti during galvanostatic cathodic polarization in 0Â·05M H_2SO_4 at c.ds. in the range 0Â·05â€“3Â·0 mA/cm^2 has been studied by direct estimation of the hydrogen content and by determination of the thickness of the Ti hydride layer. The rate of hydrogen absorption is initially linear but then becomes parabolic, indicating that hydrogen diffusion is rate controlling. From the experimental data a value of 4 Ã— $10^{â^'12}$ cm^2/s has been obtained for the diffusion coefficient of hydrogen in Ti. The mean H/Ti atom ratio of the hydride has been shown to increase from 1Â·21â€“1Â·48 with increase of c.d. The embrittling effect of the surface hydride layer has been demonstrated, and its significance has been discussed.

RÃ©sumÃ©

Par estimation directe de la teneur en H_2 et par dÃ©termination de l'Ã©paisseur de la couched'hydrure de titane, on a Ã©tudiÃ© la cinÃ©tique d'absorption de H_2 par Ti polarisÃ© cathodiquement sous 0,05 Ã 3,0 mA.cm^2 dans H_2SO_4 0,05M. D'abord linÃ©aire, la vitesse d'absorption devient ensuite parabolique, signe que la diffusion de l'hydrogÃ¨ne est le phÃ©nomÃ¨ne contrÃ´lant. Le coefficient de diffusion de H_2, trouvÃ© expÃ©rimentalement, est $10^{â^'11.4}$.cm^2.s$^{â^'1}$. Le rapport atomique moyen H/Ti de l'hydrure passe de 1,21 Ã 1,48 quand la d.c. augmente. L'effet fragilisant de l'hydrure superficiel a Ã©tÃ© mis en Ã©vidence et discutÃ©.

Zusammenfassung

Die Kinetik der Absorption von Wasserstoff in Ti wÃ¤hrend galvanostatischer katodischer Polarisation in 0,05m H_2SO_4 bei Stromdichten im Bereich 0,05â€“3,0 mA/cm^2 wurde durch direkte Bestimmung des Wasserstoffgehalts und durch Bestimmung der Dicke der Ti-Hydridschicht untersucht. Die Geschwindigkeit der Wasserstoffabsorption ist anfangs linear, wird dann aber parabolisch, was zeigt, dass die Wasserstoffdiffusion die Absorptionsgeschwindigkeit bestimmt. Aus den Versuchsdaten wurde ein Wert von 4 Ã— 10^{12} cm^2/S fÃ¼r den Diffusionskoeffizienten von Wasserstoff in Ti erhalten. Das mittlere H/Ti-AtomverhÃ¤ltnis des Hydrids erhÃ¶hte sich mit zunehmender Stromdichte von 1,21 auf 1,48. Die VersprÃ¶dungswirkung der HydridoberflÃ¤chenschicht wurde nachgewiesen und ihre Bedeutung wird besprochen.

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