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The Magnetic Susceptibility of Palladium Hydride

Sir: The linear decrease of the paramagnetic susceptibility of palladium as it absorbs hydrogen is well known.[1] The portion of the density of states curve to the right of the Fermi level is usually drawn to indicate that palladium lacks about 0.55 electron to fill the d level. It has been suggested[2] that hydrogen donates its electron to fill this d level so that when the spins are paired, the substance should become diamagnetic. This latter is observed experimentally but at a composition variously reported but close to $PdH_{0.66}$ rather than at $PdH_{0.55}$. If the above explanation is correct, it should be possible to obtain a linear increase in susceptibility as hydrogen is removed from $PdH_{\sim 0.66}$. This was attempted[3] by a high-voltage method for extracting hydrogen without heating the sample and it was claimed that all the hydrogen could be removed without any change in the magnetic susceptibility. These results were not confirmed by Lewis, *et al.*,[4] using an electrolytic method for removing hydrogen but were partially confimed in this laboratory[5] using the high-voltage method.

In the present series of experiments diamagnetic and slightly paramagnetic samples of palladium hydride were prepared from very fine (0.80-μ) palladium metal powder, by alternately heating and cooling the metal in pure hydrogen (obtained by evolution from UH_3), at a temperature which never exceeded 200° above which the powder sinters. These samples evolved hydrogen at room temperature when the hydrogen pressure above them fell below 18 mm. The magnetic susceptibility of samples of palladium hydride was continuously compared to that of a standard (Mohr's salt), while small measured quantities of hydrogen were removed from the sample, in an apparatus which has been described previously.[6] The results are shown in Figure 1. Curves 1 and 2 show that it is possible to remove a large fraction of the hydrogen from diamagnetic palladium hydride and from palladium hydride which is slightly paramagnetic owing to an initial lower

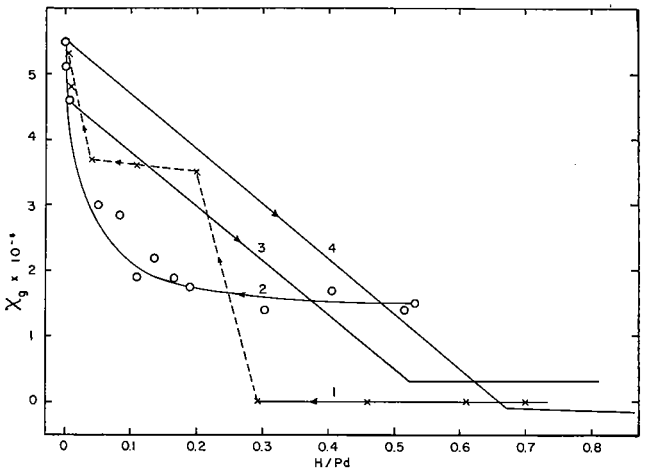

Figure 1. The effect of absorption and desorption of hydrogen on the paramagnetic susceptibility of palladium.

hydrogen content, without changing the susceptibility (χ_g). Curves 3 and 4 for the absorption of hydrogen by palladium are taken from Smith.[1] It thus appears that the band theory explanation is not tenable for the desorption of hydrogen from palladium hydride and it may be that lattice expansion plays a more important role than was formerly thought. Further experimental and theoretical work is in progress.

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