

Hydrogen-Induced Volume Expansion of fcc Pd-Cu Alloys

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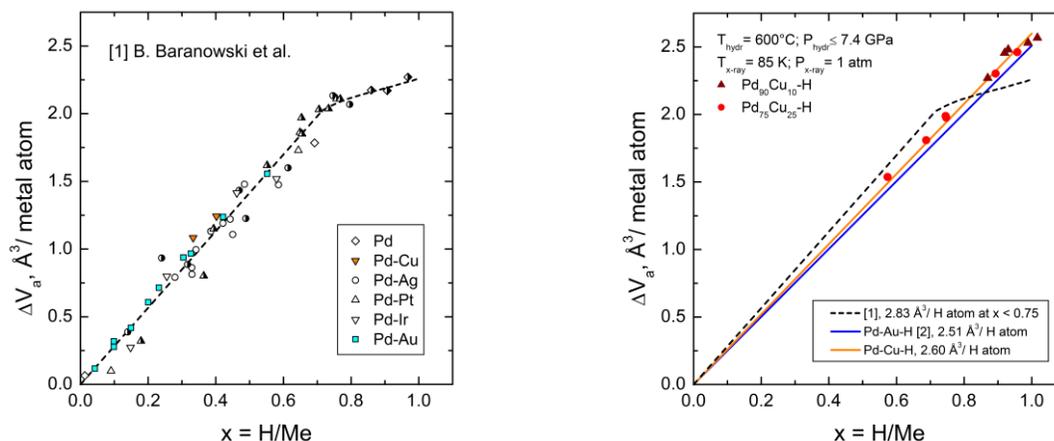
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As was first noticed in Ref.^[1], hydrogen uptake by palladium and many of its fcc alloys is accompanied by a similar, non-linear volume expansion $\Delta V_a(x)$ (see the left figure below). Our previous X-ray investigation of Pd and its alloys with 6 and 20 at.% Au loaded with hydrogen at pressures up to 7.4 GPa and an elevated temperature of 600 °C showed that the $\Delta V_a(x)$ dependences for the resulting homogeneous and stress-free solid solutions were linear and coincided with each other [2] (the blue line on the right figure). The equal slopes of all three $\Delta V_a(x)$ dependences were rather unexpected in view of the different H-Pd and H-Au interactions and significant increase in the volume of Pd doped with Au, which reached $+0.44 \text{ \AA}^3/\text{metal atom}$ in the alloy with 20 at.% Au.

In the present work, we carried out a similar X-ray investigation of stress-free solid hydrogen solutions in fcc Pd-Cu alloys with 10 and 25 at.% Cu prepared under the same $T = 600 \text{ °C}$ and $P \leq 7.4 \text{ GPa}$. Alloying Pd with Cu significantly decreases its atomic volume, the effect reaching $-0.64 \text{ \AA}^3/\text{metal atom}$ in the alloy with 25 at.% Cu. As seen from the right figure, the replacement of Au by Cu retained the linearity of the $\Delta V_a(x)$ dependences and did not noticeably change their slope.



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References

- [1] B. Baranowski et al., J. Phys. F: Metal Phys. 1 (1971) 258.
[2] V.E. Antonov et al., MH2016, Abstracts, p. 33, <https://mh2016.ch/program/>.