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Stable Palladium Alloys for Diffusion of Hydrogen

During the course of experiments designed to explore the possibility of concentrating gas chromatographic effluents by removal of hydrogen carrier gas, it was noted that a heated palladium tube (25% silver) failed after a few weeks of continuous use.

The results of a literature survey suggested that failure of the palladium tubes occurred because of stresses set up when an alpha phase is converted to a beta phase by absorption of hydrogen and back to the alpha phase when hydrogen is lost; deformation occurs because the crystal lattice of the beta form is larger than that of the alpha form. Additionally, the survey provided ample evidence that interstitial impurities strongly influence the aging mechanism of the cold-work peak of hydrogen in palladium; as little as 0.001% of silicon can induce discontinuous yielding effects in palladium.

A systematic search for information on the effect of hydrogen absorption on palladium alloys revealed the existence of a number of alloy compositions in which an alpha–beta transition does not take place; for example, palladium alloyed with either 10% rhodium, 5% nickel, or 10% silver–5% nickel show excellent stability to temperature cycling in a hydrogen atmosphere. Alloys containing 35% silver or 30 to 40% gold also resist temperature cycling, but they are especially interesting because they show excellent diffusion rates (about half that of pure palladium).

Conclusions drawn from the literature survey are: (1) A 40% gold alloy of palladium should be used in place of palladium – 25% silver alloy for separator tubes; (2) The alloy must be free of interstitial impurities; (3) The metallic surfaces of the tube must be scrupulously clean.

Note:

Requests for additional information may be directed to:

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