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## II.C.7 High Flux Metallic Membranes for Hydrogen Recovery and Membrane Reactors

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### Objectives

Investigate new alloys of lower-cost transition elements to achieve basic improvements in metallic membrane technology to extract hydrogen at the appropriate purity.

### Introduction

Palladium silver membranes have been used for decades to provide hydrogen purification, but palladium silver is expensive and soft. This project will investigate new alloys of lower-cost transition elements to achieve basic improvements in metallic membrane technology to extract hydrogen at the appropriate purity. It has been shown that, when coated with palladium, tubes and foils of Group 5B metals and alloys are substantially superior to palladium-silver in terms of hydrogen flux, uncontrolled failure and, most importantly, expense.

### Approach

About 100 alloy and intermetallic compositions will be fabricated and tested for toughness, embrittlement, permeation, and ease of manufacture. The most innovative of these are B2 intermetallics, though higher-melting-temperature refractory alloys will also be studied. Originally, two types of coatings will be tried: palladium and B2 phase palladium copper. Both materials dissociate and permeate hydrogen readily, and the B2 phase alloy is sulfur tolerant as well. It is expected that B2 phase alloy will exhibit less interdiffusion. The first alloy samples will be produced as foil coupons, and later (once the alloy selections are narrowed) as tubes. To save time and cost, the first, small runs of membrane samples will be coated by vapor deposition in vacuum. Subsequent membranes and all tubes will be coated by electroless deposition or cladding since these methods are amenable to commercial use.

### Accomplishments

- Fabricated and tested several alloy and intermetallic compositions for toughness, embrittlement, permeation, and ease of manufacture.
- Prepared foil coupons of alloy samples of palladium and B2 phase palladium copper based on tests that showed both materials dissociate and permeate hydrogen readily with added sulfur tolerance from the B2 phase alloy, although it is expected that the B2 phase alloy will exhibit less inter-diffusion. The first alloy samples will be produced as foil coupons.

### Future Directions

Prepare tube samples of selected alloy samples and coat by vapor deposition in vacuum. Subsequent membranes and all tubes will be coated by electroless deposition or cladding since these methods are amenable to commercial use.