Testing of Engineered Membranes in Fusion-Relevant Metal Foil Pumps

Topic Area: Enabling Technologies

Partner	Company
Colorado School of Mines	Marathon Fusion
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Project Summary:

Mines investigated the impact of intentional (e.g. Ar) and unintentional (e.g. C,O) impurities on the performance of Pd-based metal foil pumps (MFPs) for direct internal recycling (DIR).

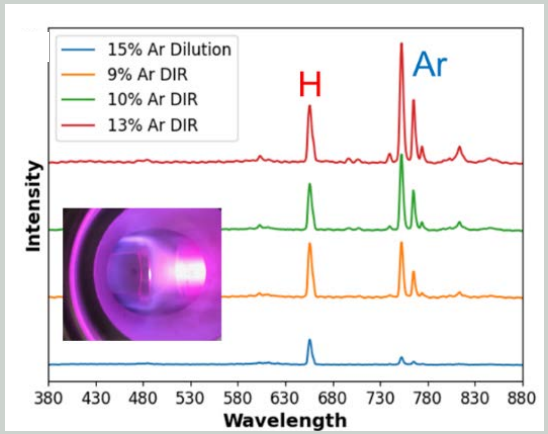
Fusion Impact:

Understanding MFP durability and developing remediation strategies essential for practical implementation. Dissemination:

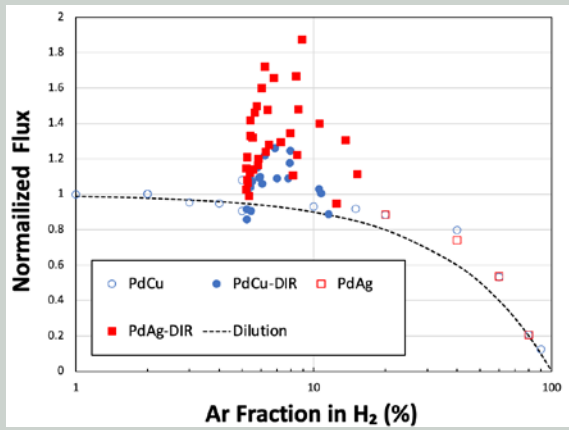
C. L. Hufnagel, V. Camacho, T. F. Fuerst, A. Rutkowski, J. D. Way, and C. A. Wolden, "The impact of argon addition on hydrogen superpermeation through palladium alloy metal foil pumps during direct internal recycling," *Fusion Engineering and Design* **222**, 115428, (2026).
C. A. Wolden, Presentation at 48th DOE Tritium Focus Group, Devens, MA, 2025.

Business/Market Impact:

- Must study under DIR operation to understand full impact.
- PdCu offers higher flux, but PdAg more robust to impurities.



OES spectra showing limited H emission from Ar/H_2 mixtures w/o DIR but significant plasma enhancement during DIR



Normalized flux with respect to pure H_2 as a function of Ar addition. No benefit observed w/o DIR (open symbols) but enhancement under DIR (filled)

Benefits greater for PdAg than PdCu

Period of Performance:	Federal Share:	Cost Share:
9/2024 – 8/2025		