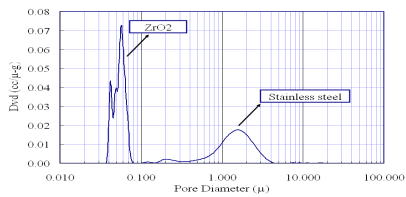


Substrate Development

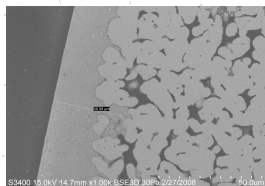
"It is all about substrate!!!! - Prof. Douglas Way"



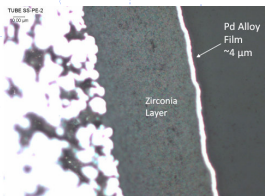
- Ceramic Coated Porous Stainless Steel Substrates
- Available in 316L and 310 SS with welded fitting



- Uniform pore size distribution
- Average Pore Size = 70 nm
- First Bubble/Largest Pore > 30 psig
- Air Permeance = 1.9×10^{-2} scc cm⁻² s⁻¹ cmHg⁻¹

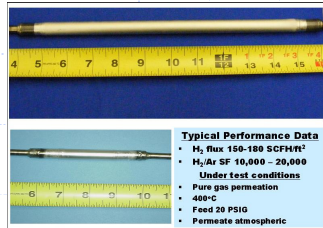


- Excellent adhesion between Stainless Steel and ceramic layer.



- Excellent adhesion to zirconia layer, uniform thickness, surface contour following of Pd-alloy metal film

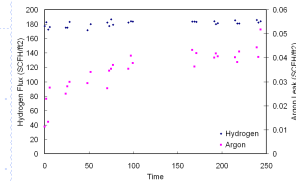
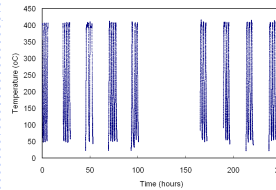
Hydrogen Separation Membrane



➢ Syn-gas automated Testing Capability

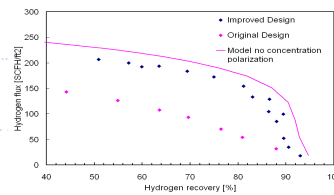
Each spike represents a thermal cycle

Environment: Air → Air → Argon → H₂ → Air
 Pressure (psig): 0 → 20 → 20 → 20 → 0
 Temperature (C): 25 → 400 → 400 → 400 → 25
 Temperature ramp-up/down in 1 hour



Palladium-Alloy membranes

- Composite and alloy development in collaboration with CSM.
- Extensive fabrication and testing.
- Robust: Thermal stability and start-up/shut-down cycling test.
- Module design and innovation to improve performance.
- 15cm² modules available for field testing.



➢ Engineering design optimization for enhanced performance. Data at 400 C; 75 psig feed pressure; 70/30::H₂/Ar, Atmospheric permeate

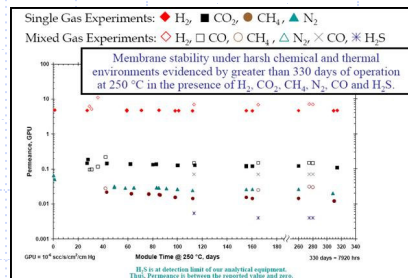
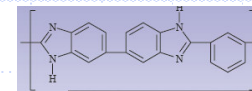
Progressing towards Industrial Scale

- Large scale manufacturing capability.
- Unique weld design developed and commercialized.
- Porous stainless steel and ceramic coated stainless substrates suitable for high temperature and pressure gas and vapor separation applications.



Polybenzimidazole Membrane

- High temperature polymeric membrane development in collaboration with Los Alamos National Laboratory
- Long term stability at temperatures exceeding 250 C.
- Exceptional stability in H₂S and CO environment.
- Innovative composite design for 25 fold performance improvement.



	Pure Gas H ₂ Permeance [GPU] 250 C	Ideal H ₂ /CO ₂
Membrane 1	180	22.6
Membrane 2	166	23.8

➢ Recent Data – Optimized composite design

➢ Contact

Scott Hopkins, Technical Director
 email: scott.D.hopkins@pall.com
 Phone: 6077536041

Ashok Damle – Business Manager
 email: Ashok.damle@pall.com
 Phone: 5164843600

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