

Appendix A
Helium in Metals Analysis (pg. 1)

Behavior in Metals at or Near STP	Hydrogen	Helium
Permeates (Diffuses) Through Intact and Defect-Free Metal	Yes	No
Permeates (Diffuses) Through Defects and Grain Boundaries	Yes	Yes
Soluble (Dissolves) in Metal	Yes	No

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Appendix A

Helium in Metals Analysis (pg. 2)

References:

SRI did not test helium retention hypothesis during experiment.

EPRI TR-107843-V1 pg. 357

Bockris et al. showed helium on near-surface areas on cathode can be retained if quickly immersed in liquid nitrogen.

Chien, Chun-Ching, Hodko, Dalibor, Minevski, Zoran and Bockris, John O'M. "On an Electrode Producing Massive Quantities of Tritium and Helium," Journal of Electroanalytical Chemistry, Vol. 338, p. 189–212, (April 1992)

Gozzi showed that helium does not show up in the bulk if the cathode is vaporized.

Gozzi, D., et al., "X-Ray, Heat Excess and 4He in the D:Pd System," Journal of Electroanalytical Chemistry, Vol. 452, p. 253, (1998) and Erratum, 452, 251–271, (1998)

Helium won't dissolve in metal even at high temperature.

Ramsay, W.; Travers, M.W. "An Attempt to Cause Helium or Argon to Pass through Red-Hot Palladium, Platinum, or Iron." Proceedings of the Royal Society of London (1854-1905). 61 (-1), p. 266-267. Jan. 1897, doi:10.1098/rspl.1897.0034

Defect-free metal will not allow helium to pass through.

Schultheis, D., "Permeation Barrier for Lightweight Liquid Hydrogen Tanks," Ph. D. thesis, University of Augsburg, 2007

Helium does not outgas from metals easily or quickly.

Bowman, Jr., Robert C., "NMR Studies of 3He Retention and Release in Metal Tritides -A Review," Hydrogen & Helium Isotopes in Materials Conference, Albuquerque, NM, USA, Feb. 7 2007

Helium may pass through metals above 350 kPa.

Rothenberger, Kurt S. et al., "High Pressure Hydrogen Permeance of Porous Stainless Steel Coated with a Thin Palladium Film via Electroless Plating," Journal of Membrane Science, Volume 244, Issues 1-2, 15 November 2004, Pages 55-68

Helium is known to have low solubility in metals, grain boundaries support permeation.

Xia, Ji-xing, Hu, Wang-yu, Yang, Jian-yu, Ao, Bing-yun, " Diffusion Behaviors of Helium Atoms at Two Pd Grain Boundaries," Trans. Nonferrous Met. SOC. China 16(2006) s804-s807