# Chemical Compatibility Issues for Refractory Metals in Helium-Based Working Fluids

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Chemical compatibility issues associated with the use of refractory metals in reactor systems that use a helium working fluid (for example, Brayton cycle) are discussed. Previous studies of the contamination of refractory metals at low oxidant pressures typically found in a helium working fluid are reviewed, as is related work done in support of corrosion of nickel-based alloys in helium used as a coolant in high-temperature gas-cooled reactors.

Compatibility criteria related to contamination are approximated for various refractory metals in all-gas systems as well as in systems with the alloy exposed to gas on one side and molten lithium on the other. Estimates of contamination burdens can be obtained from models of varying sophistication and, when combined with such compatibility criteria, can be used to assess whether impurity levels are sufficient to limit the lifetime of refractory metal components. However, while it is clear that some contamination of refractory metals will occur in an inert-gas working fluid, even qualitative prediction of whether this contamination is life-limiting is hampered by the lack of certain design-specific data and fundamental kinetic information related to impurity release and uptake.

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