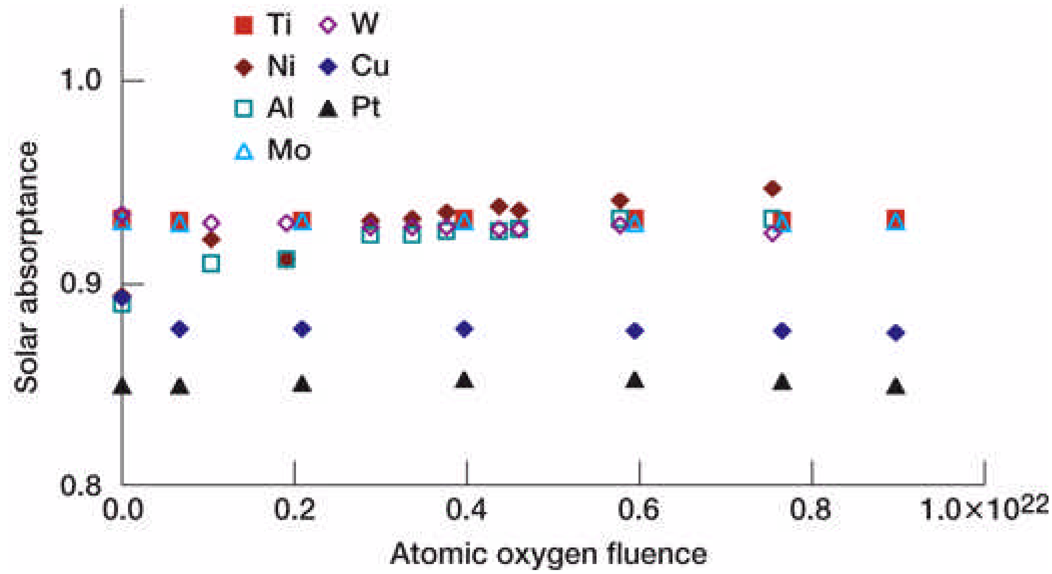
Solar Absorptance of Cermet Coatings Evaluated

Cermet coatings, molecular mixtures of metal and ceramic, are being considered for the heat inlet surface of solar Stirling convertors. In this application, the key role of the cermet coating is to absorb as much of the incident solar energy as possible. To achieve this objective, the cermet coating has a high solar absorptance value. Cermet coatings are manufactured utilizing sputter deposition, and many different metal and ceramic combinations can be created. The ability to mix metal and ceramic at the atomic level offers the opportunity to tailor the composition, and hence, the optical properties of these coatings. The NASA Glenn Research Center has prepared and characterized a wide variety of cermet coatings utilizing different metals deposited in an aluminum oxide ceramic matrix. In addition, the atomic oxygen durability of these coatings has been evaluated.

The cermet coatings are typically 250 nm thick, and they are purposely made to be metal rich at the substrate-coating interface and ceramic rich at the surface, with the composition of metal and ceramic changing through the thickness of the coating. As a consequence of the changing composition, islands of metal form in the ceramic matrix. Diffusion of the metal atoms plays an important role in island formation, whereas the ceramic plays an important role in locking the islands in place as-formed. Much of the solar spectrum is absorbed as it passes through the labyrinth.

The following metals were utilized to make cermet coatings, in conjunction with an aluminum oxide ceramic: aluminum, nickel, titanium, platinum, copper, and molybdenum. Tungsten was used to make a cermet coating in conjunction with an aluminum nitride ceramic. Of the cermet coatings evaluated to-date, the titanium/aluminum oxide combination and the molybdenum/aluminum oxide combination offer the best optical properties, having a solar absorptance value of 0.93. Both coatings are durable to atomic oxygen, as indicated in the graph, and additional testing is underway to identify coating durability with respect to vacuum ultraviolet radiation and high temperatures.



Solar absorptance of several cermet coatings as a function of effective atomic oxygen fluence.

Find out more about this research: http://www.grc.nasa.gov/WWW/epbranch/

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