



Oxidation Resistant Coatings for Ultra-High Temperature Transition Metals and Metal Alloys

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a multilayered coating for the surface of Mo-Si-B alloys.

Overview

Components that operate under high temperatures and pressures, such as those used in turbines and airplane brakes, require materials with excellent chemical and physical properties. Nickel-based alloys (or superalloys) are the current industry standard for these applications. Coating nickel alloys with aluminum oxide and thermal barriers allows the final product to withstand temperatures beyond the melting point of nickel. However, there is a growing need for products with properties that nickel cannot achieve.

Solarthermal chemical processing also requires materials that are resistant to oxidation and thermal shock. Solar energy potentially could be concentrated and used to reach high temperatures so it could directly drive some chemical reactions, such as those involved in the production of syngas. However, suitable materials are not yet available.

Molybdenum-silicon-borate (Mo-Si-B) alloys could potentially supercede nickel and other currently used materials due to their ability to withstand even greater temperature changes and pressures than existing metals and alloys. Until now, however, no effective means existed to prevent these alloys from oxidizing completely away under high temperatures.

The Invention

UW-Madison researchers have developed a multilayered coating for the surface of Mo-Si-B alloys, which includes a diffusion barrier layer, an oxidation resistant layer and an oxidation barrier layer. The coatings form a stable gradient of integrated layers that prevents cracking, peeling and delamination of Mo-Si-B alloys under extreme operating conditions.

Applications

- Components that operate under high temperatures and pressures, such as those in turbines, airplane brakes and solarthermal processing units

Key Benefits

- Can withstand very high operating temperatures without consuming the alloy
- Resistant to cracking, peeling and delamination under the extreme temperatures and pressures occurring under operating conditions
- The oxidation barrier can be applied to a range of substrates, particularly alloys of molybdenum, silicon and boron.
- The oxidation barrier may be multilayer, multiphase or contiguous.

- All methods use current processing techniques
- To further extend the operating temperature range, a thermal layer can be applied to the oxidation barrier using conventional techniques (such as thermal spray or spray deposition).

Additional Information

For More Information About the Inventors

- [John Perepezko](#)

Related Intellectual Property

- [View Divisional Patent in PDF format.](#)
- [View Continuation Patent in PDF format.](#)

Publications

- Park J.S., Sakidja R. and Perepezko J.H. 2002. Coating Designs for Oxidation Control of Mo-Si-B Alloys. Scripta Mater. 46, 765-770.
- Weimer A.W. 2012. Solarthermal Chemical Processing Challenges and Commercial Path Forward. Curr. Opin. Chem. Eng. 1, 211-217.

Tech Fields

- [Materials & Chemicals : Composites](#)
- [Materials & Chemicals : Metals](#)

For current licensing status, please contact Emily Bauer at emily@warf.org or 608-960-9842