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Method for Achieving Corrosion Resistance of Solids in Molten Salts

Chemically-tailored solid materials provide cost-effective, high-performance corrosion resistance in extreme high-temperature molten salt systems, extending device and system life.

In high-temperature heat transfer liquids and high-temperature thermal storage liquids, molten salts make contact with a number of solid materials. Such solid materials require corrosion resistance to molten salts at high temperature in order to allow for prolonged, cost-effective use of molten salts. Unfortunately, molten salts tend to be corrosive to solid materials, including solid metals, metal alloys, metal-bearing composites, ceramics, and ceramic-bearing composites. Corrosion of solid materials leads to the degradation of mechanical and thermal properties. Current methods to improve corrosion resistance of solid materials are complex, not very effective due to leaks, and requires monitoring of oxygen and or water levels, which increases the cost of such methods. There is a need for new cost-effective methods to protect such solid materials from corrosion.

Researchers at Purdue University have developed methods for achieving corrosion resistance in mechanically robust, thermally conductive metals, metal alloys, metal-bearing composites, ceramics, and ceramic-bearing composites in high-temperature, corrosive liquid environments that contain molten salts. This method involves appropriate chemical tailoring to achieve desired corrosion resistance for the solid material in the salt.

Use of such solid materials (metals, metal alloys, metal-bearing composites, ceramics, and ceramic-bearing composites) in high-temperature systems include transportation, energy production, energy storage, waste heat recovery, propulsion, national defense, chemical processing, and chemical and waste storage. Components include heat exchangers, piping, valves, storage containers for high-temperature solids and liquids, pumps, bearings, heat sinks, liquid metal handling equipment, engine components, leading edges of hypersonic aircraft and missiles, and energy conversion devices.

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Materials Science & Nanotechnology/Thermal Management Materials & Solutions

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Advantages:

-Corrosion-resistant solid materials for prolonged high performance of devices and systems

-Reduced costs for operating devices and systems due to prolonged device and system life

Potential Applications:

-High temperature systems include transportation, energy production, energy storage, waste heat recovery, propulsion, national defense, chemical processing, and chemical and waste storage

-Components include heat exchangers, piping, valves, storage containers for high-temperature solids and liquids, pumps, bearings, heat sinks, liquid metal handling equipment, engine components, leading edges of hypersonic aircraft and missiles, and energy conversion devices

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