frontiers | Frontiers in Materials

EDITORIAL
published: 18 May 2022
doi: 10.3389/fmats.2022.920811

Editorial: Thermal Protection Materials and Coatings

Hao Zhang[1], Hongsong Zhang[2], Xiaolong Chen[3] and Xin Zhou[4]*

[1]Jiangxi Key Laboratory of Surface Engineering, School of Materials and Mechanical & Electrical Engineering, Jiangxi Science and Technology Normal University, Nanchang, China, [2]College of Mechanical Engineering, Henan University of Engineering, Zhengzhou, China, [3]Institute of Advanced Wear & Corrosion Resistant and Functional Materials, Jinan University, Guangzhou, China, [4]Institute for Advanced Studies in Precision Materials, Yantai University, Yantai, China

Keywords: thermal protection, thermal barrier coating, polymer matrix composite, superalloy, high entropy, laser cladding, corrosion resistance

Editorial on the Research Topic

Thermal Protection Materials and Coatings

With the advancement of science and technology and the development of industry, especially the rapid development of aviation, aerospace, energy, metallurgy and other industries, the requirements for the working temperature of materials are higher and higher, and the service environment is more and more harsh. Under such conditions, problems such as high-temperature oxidation and corrosion damage of metal materials are inevitable, and these engineering technical difficulties seriously hinder the development of the industry. The developments of new high-temperature structural materials and high-temperature protective coatings are key technologies to increase the operating temperature of materials and to provide effective thermal protection for materials. In particular, high-temperature protective coatings can usefully improve the oxidation and corrosion resistance of metal materials at high temperatures, and have been widely applied in industrial fields. This special issue features original research articles on several topics in thermal protection, including superalloys, bonding layer materials, thermal protective coatings and thermal barrier coating materials, and thus highlights the latest developments of high temperature corrosion and protection fields. In addition, this special issue also holds the latest research results on the corrosion resistances of structural materials for nuclear power plants, waste incinerators and other industrial fields.

In Liu et al., Liu developed a new type of Co-20Re-25Cr-3Si (at%) superalloy, which shows good oxidation resistance under laboratory air at 1,273–1,473 K due to the dense and continuous Cr_2O_3 film formed on the surface of the alloy. However, Cr_2O_3 thickness gradually became thinner because of its evaporation and decomposition with increasing temperature. Consequently, Co-20Re-25Cr-3Si superalloy presented the best oxidation resistance only at 1,273 K. In recent decades, polymer matrix composites (PMCs), the fourth type of structural materials, have been used in aircraft because of their light weight and high strength. However, their wide applications are greatly limited by the poor erosion and abrasion resistance, bad thermal oxidation resistance and low working temperature. The functional protective coatings can effectively improve the limitations. Zhou et al. proposed a Cu/NiCrAlY/YSZ triple layer coating system deposited on glass fiber reinforced PCMs. This system has low thermal conductivity, and Cu bonding layer prepared by high velocity oxygen fuel (HVOF) has strong mechanical interlock with the substrate. As a result, this kind of coating provided good thermal protection for the substrate.

Significant interests have been devoted on the high-temperature protective coatings, which are generally classified into three categories, namely, thermal diffusion coatings, MCrAlY (M = Ni, Co, or Ni+Co) cladding coatings and thermal barrier coatings. Li et al. reported the Ni-based aluminide coating prepared by pack cementation, and explored its high-temperature oxidation and corrosion

OPEN ACCESS

Edited and reviewed by:
Valeria Cannillo,
University of Modena and Reggio Emilia, Italy

****Correspondence:***
Hao Zhang
zhangyinghao1985@126.com

Specialty section:
This article was submitted to Ceramics and Glass, a section of the journal Frontiers in Materials

Received: *15 April 2022*
Accepted: *22 April 2022*
Published: *18 May 2022*

Citation:
Zhang H, Zhang H, Chen X and Zhou X (2022) Editorial: Thermal Protection Materials and Coatings. Front. Mater. 9:920811. doi: 10.3389/fmats.2022.920811

behavior in Na_2SO_4 salt at 1,323 K. Special emphasis was given on the pre-oxidation treatment, which is beneficial to improve the corrosion resistance of aluminide coating. Gong et al. presented a Sm_2O_3 modified NiCoCrAlY coating prepared by laser cladding. Sm_2O_3 addition changed the oxidation mechanism of the coating, and the appropriate Sm_2O_3 concentration can effectively improve the oxidation resistance of the coating. Chen et al. developed a series of novel ceramics with $(La_{1-x}Ho_x)_3NbO_7$ (x = 0/6, 1/6, 2/6, 3/6, 4/6, 5/6, and 6/6) compositions. The good mechanical properties and excellent thermophysical properties of $(La_{1-x}Ho_x)_3NbO_7$ solid solutions make them promising candidates for thermal barrier coating top coat.

The research of corrosion behaviors of other structural materials such as aluminum alloys is another hot topic of this special issue. Zhu et al. reported a vanadium and tannic acid-based composite conversion coating with self-healing ability to improve the corrosion resistance of 6063 aluminum alloy. Wei et al. presented the corrosion behaviors of 304 stainless steel used in nuclear power plants under pressurized water reactor (PWR) primary side conditions. Zinc injection to the primary side chemistry can effectively enhance the corrosion resistance of 304 stainless steel. Bai et al. designed an AlFeNiMoNb high-entropy alloy (HEA) modified 904L stainless steel used for waste incinerators. This alloy showed the best chloride corrosion resistance at 973 and 1,073 K and thus may be suitable for applications in an oxidizing chlorine-containing atmosphere above 973 K.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

ACKNOWLEDGMENTS

We would like to thank all contributing authors to the issue, and the editorial staff of Frontiers in Materials for making this special issue possible.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.