STRYKE

INNOVATIVE THERMAL PROTECTION ARCHITECTURE FOR HYPERSONIC STRUCTURES

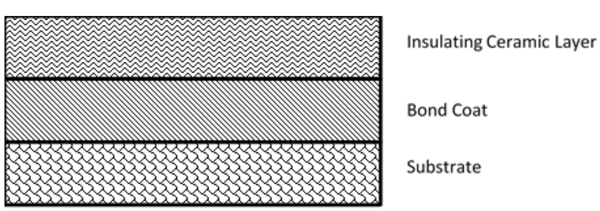
Background / Problems:

High-speed strike weapons and long-range precision fires systems have unique structural component design challenges due to stand-off range requirements. The overall system stressors associated with this flight regime require significant advancements in ruggedized and lightweight materials supporting the leading edges and other control surfaces. These surfaces undergo extreme frictional heating during high-speed flight and are essential to system success. As such, developing advanced materials and structures capable of withstanding such intense temperatures and environments is of critical importance to multiple industries (e.g., aerospace, defense, government, industrial).

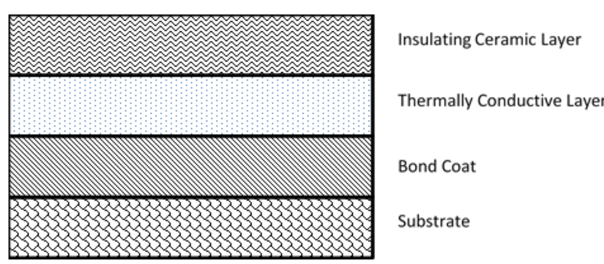
Solution:

Stryke has conceived and designed a novel, patent-pending, thermal barrier architecture that may provide an important breakthrough for aerospace leading-edge structures and other thermally challenged systems. Our technical approach builds on the traditional thermal barrier coatings (TBCs), which provide significant thermal insulation for systems where high-temperature operating environments commonly degrade standard structural materials. We incorporate a thermally conductive dissipation layer to reduce thermal gradients and lower the temperatures experienced by the structural component in high heat flux environments. While still under development, this concept aims to provide an innovative next generation solution for many industrial and aerospace applications. See the graphic below:

Traditional TBC Architecture



Innovative TBC Architecture



Stryke's innovative TBC architecture incorporates a thermally conductive layer to help rapidly dissipate heat from high flux environments.

Features and Benefits:

The thermally conductive layer can be tailored to meet the requirements of the end application. Two materials under consideration are copper and highly oriented graphite. Copper exhibits an isotropic thermal conductivity of approximately 400 W/m-K, while highly oriented graphite provides anisotropic conductivity in the range of 1,700 W/m-K in-plane and approximately 5 W/m-K through-plane.

In both examples, the high in-plane conductivity will rapidly dissipate heat parallel to the substrate's surface. This property will be particularly advantageous for high heat flux environments such as those at leading edges of hypersonic structures where only a very small surface area is exposed to the extreme temperatures. This extremely high heat flux often causes internal stress build-up due to thermal gradient mismatches across neighboring parts of the structure. By rapidly and efficiently spreading this heat, those gradients will be significantly reduced and so will the build-up of thermally induced stresses.

Key Features of Stryke's TBC Architecture:

- Can be applied alongside numerous combinations of materials
- Supports diverse hypersonic operating environments
- Can be tailored to application requirements by optimizing the different material layer combinations, thicknesses, and porosities

The highly oriented graphite has the added benefit of providing exceptional in-plane thermal dissipation while also inhibiting phonon transport through-plane; thereby further insulating the underlying bond coat and substrate. Since both materials have pros and cons associated with them, we have planned additional evaluations to define the respective attributes and applications.

Status and Way Ahead:

The proposed hybrid thermal barrier coating architecture has been developed by Stryke Industries and intellectual property has been filed to protect the invention. Trial plans and proof of concept evaluations are currently being developed to provide quantifiable comparative data between traditional TBCs and the developed solution.

Stryke is actively seeking government and industry partners to assist in the development, characterization, and maturation of the proposed technology for hypersonic and other thermal protection applications. While the core concepts and materials knowledge is held within Stryke, an ideal partner would bring in-depth applications understanding and relevant environment requirements to ensure the most efficient and rapid technology maturation.

About Stryke:

Stryke Industries, headquartered in Ft. Wayne, Indiana, is a small, non-traditional defense contractor specializing in the deployment of novel materials and technology within defense, commercial, and government arenas. With technical focus areas of thermal management, advanced materials, artificial intelligence, encryption, spectrum, and directed energy, Stryke has, and continues to be, a key participant in many OTA and traditional R&D programs. Stryke utilizes its core competencies, expertise, and technologies to bring complete, innovative, and valuable solutions to its customers and clients.

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