PhD Studentship: Adhesion strength of environmental barrier coatings on SiC/SiC CMCs for aerospace.

Department/Faculty: Department of Materials, Faculty of Engineering
Campus: South Kensington
Duration: 42 months, starting as soon as possible (starting date can be agreed with supervisor)

Supervisor: Dr. Nasrin Al Nasiri

This PhD project aims to study the adhesion strength of environmental barrier coatings (EBCs) applied on silicon carbide (SiC) ceramic matrix composites (CMCs) to develop the next generation of gas turbines that are faster, cheaper, lighter, more efficient and less pollutant.

A major breakthrough in gas turbine’s performance (cycle efficiency, reduce noise and emissions) requires a new generation of structural materials having an operative temperature higher than the alloys currently used. Ceramic matric composites (CMCs) exhibit superior high temperature strength and durability that will revolutionize the new generation of engines. In addition, the low density of CMCs allows weight savings of up to 30% compared to Ni-based alloys thus leading to simple and compact design. CMCs have reached the degree of maturity that allows them to be used for the next generation of gas turbines. Si-based ceramics have excellent oxidation resistance due to formation of a protective silica layer on reacting with dry air. However, the same silica layer will react with water vapour to form gaseous silicon hydroxide, leading to high recession and component failure. To avoid this behaviour, a prophylactic environmental barrier coating (EBC) is required. A variety of EBCs have been developed in the past consisting of a minimum of 4 layers requiring a costly application method such as plasma spraying. Dr. Al Nasiri’s group has developed a reliable single layer of EBC using a low cost applying method.

Understanding the adhesion strength at the interface of the coating-substrate and study the failure mechanisms under different loading conditions and environments is essential to predict accurately the service life of the coating and ensure they survive their design conditions.

- The objectives of this project are: To develop mechanical testing methodologies that will enable an accurate and reliable characterization of the adhesion strength at the coating/CMC interface using the single layer approach.
- To combine systematic mechanical testing and structural characterization in order to develop a deep understanding of the parameters that control adhesion, delamination, spallation and the models needed to support the design of new materials.

The qualified candidates will join a dynamic research team with a research focus on ceramics fabrication and performance in the Center for Advanced Structural Ceramics at the department of Materials at Imperial College London. Applicants should have knowledge in one or more of: ceramics microstructures, electron microscopy or mechanical testing. Good teamwork and communication skills are essential. In addition, the candidates should have (or be expecting to obtain) a first degree (1st class or upper second class) in materials, mechanical engineering or a relevant subject.

This 3.5-year studentship will provide full ‘home rate’ fees plus the standard maintenance stipend to UK and EU students who meet the residency criteria (currently a stipend of £16,777).
Applications will be processed as received. For questions or further details regarding the project, please contact Dr. Nasrin Al Nasiri (n.al-nasiri10@imperial.ac.uk).

Applications will be considered until a suitable candidate has been found.

For questions regarding the admissions process, please contact Materials student office (materialsstudentoffice@imperial.ac.uk). Formal applications can be completed online: http://www3.imperial.ac.uk/materials/research/phdopportunities while information about the Department can be found at http://www3.imperial.ac.uk/materials.

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