Master Thesis Project

Making $TiAl/Al_2O_3$ metal matrix composite powder for surface coating applications

Background

Titanium aluminide (TiAl) based alloys are considered good candidate materials for high temperature applications due to its excllent properties such as low density, oxidation resistance above 500 °C and high hardness but this is limited by the elevated production cost.

These mix of properties make TiAl atractive in aerospace applications in which the use of lightweight materials significantly reduces the fuel consumption as alternative to the conventional high temperature Ni-base supperalloys.

For example: TiAl is being used to produce low pressure turbine blades with Electron Beam Melting (EBM) for GE Aviation's GE9X jet engine, which powers the Boeing 777X jet (Fig. 1).

Fig.1 courtesy Avio Aero

Additionally, the TiAl-based intermetallic matrix composite such as Ti/Al_2O_3, $TiAl/Al_2O_3$, and Ti_3Al/Al_2O_3 have proved promising for their ability to be used for surface coating applications to improve wear resistante at high temperatures. The bulk of material produced from this processing step of this research work will be Ti/Al_2O_3, $TiAl/Al_2O_3$, and Ti_3Al/Al_2O_3 different titanium base composite material powders.

Description of the thesis work

The scope of this thesis is to develop a processing route to obtain Ti/Al_2O_3, $TiAl/Al_2O_3$, and Ti_3Al/Al_2O_3 composite powder particles. These composite material powders will be prepared according to different stoichiometric ratios starting from aluminium metal powder and titanium dioxide powder. These base materials will be mechanically mixed and subjected to heat treatment under inert gas atmospheric protection. Analysis of the resulting powder particles will be a key part of the thesis work. Morphology, particle size distribution, chemical composition and flowability properties will be tested by using latest state-of-the-art equipment.

Organization

The thesis work will be performed at the Department of Industrial and Materials Science at Chalmers in the frame of the Centre for Additive Manufacturing – Metal (CAM^2: https://www.chalmers.se/en/centres/cam2/Pages/default.aspx). The student will have access to expertise in metallurgy, powder characterization and thermal properties analysis. The student will be free to explore suitable approaches and propose a research plan to conduct the experimental work.

Qualifications: Interest and curiosity in the subject, good knowledge of material science and interest for new technologies, as well as good analytical skills.

Detail: 30 hp master thesis project, starting is as soon as possible but no later than January 2022.

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