Selective laser sintering of bio-inspired composite structures

Summary

This PhD position is being offered to a researcher ready to be involved in additive manufacturing through selective laser sintering of composite materials in-situ reinforced by ceramic phase. The principal of bio-mimicry will be applied to the designed structures to ensure their high wear resistance.

Research field:	Mechanical engineering
Supervisor:	Prof. Dr. Irina Hussainova
Availability:	This position is available.
Offered by:	School of Engineering Department of Mechanical and Industrial Engineering
Application deadline:	Applications are accepted between September 01, 2021 00:00 and September 30, 2021 23:59 (Europe/Zurich)

Description

The project aims at far beyond the state-of-the-art platform for production of the bioinspired complex structured composites. The objective is development of light-weight highly wear resistant structures successfully working in tribo-conditions exploiting bio-replication of architecture and gradients of bone (energy absorption) and surface texturing of snake (low friction and wear). The ultimate goal of the project is twofold: (i) development of materials solutions allowing gradient manufacturing and in-situ reinforcement during AM through Selective Laser Melting/Sintering (SLM\S); and (ii) development of a technological procedure for modulating the local composition and structure for sintering lightweight reliable wear resistant composites.

For SLM, the interaction between the laser beam and powder material is one of the dominant phenomena defining the feasibility and quality of process. To meet the demands, new adopted materials should be developed with the shape and size tolerances and compositions modified to fit the process. The use of computational thermodynamics can guide in the tailoring of the phases comprising their interfaces and spatial distributions. However, defining the optimum material distribution function requires extensive knowledge of material data that includes the chemical composition, its characteristics and manufacturing constraints. Among the Al-based alloys, the most studied is AlSi10Mg. Very few alloys consisting transitional elements to stipulate on in-situ hardening through formation of intermetallic phases are detailed. Study on AM of an innovative Al-Mg alloy modified with Sc and Zr (Scalmalloy) is at very beginning, but results are promising. Some alloys being under protection are not studied yet. Moreover, AM of ceramic and ceramic-metal composites are far from mature.

Applicants should fulfil the following requirements:

A suitable background may come from industrial engineering, materials engineering, mechanical engineering or related disciplines with ICT background. Prior experience in engineering software (SolidWorks, NX, AutoCad, etc) is highly appreciated. The applicant should prove his/her capabilities in writing technical reports and scientific papers in high quality journals. Priority will be given to those who have received first-class honors for their bachelor's degree and master's by coursework with research components and/or publications. The applicant for the position must have a master’s degree and must fulfil the requirements for doctoral students at TalTech.

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