Training Opportunity for Swiss Trainees

Reference	Title	Duty Station
CH-2016-TEC-QTE(2)	**Tunable nanocomposites for 3D manufacturing for space applications**	**ESTEC**

Overview of the unit's mission:

The Materials and Component Technology Division, within the Product Assurance and Safety Department, covers Space Materials and Electrical, Electronic and Electromechanical (EEE) components Technology R&D, reliability assessment and industrialisation and is responsible for the technical management of materials and components space evaluation and qualification programmes. Furthermore, the Division manages the technical support and procurement of Materials, Processes and EEE-components for ESA-projects.

Overview of the field of activity proposed:

3D printing technology is already changing our everyday life, but could also allow to create on-demand objects needed in space stations. The possible applications could range from creating spacecraft parts until printing of shields from the lunar regiolith mineral for the moon bases. A number of non-metallic materials, such as the PEEK polymer, already proved suitable for this kind of processing.

Tunable properties are a desirable feature of the aerospace materials. A bottom-up approach to achieve such properties is provided by nanotechnology. Nanodispersion of one phase in a 3D-printable matrix phase could influence e.g. the gradients in thermal/electrical conductivity, its mechanical or optical properties. Currently for a number of systems the mean size and aggregation state of the nanoparticles can be well-controlled. Thus nanoparticulate additives may lead to new multifunctional hybrid materials.

Within this project the trainee will be requested to review the existing literature on 3D printing using nanocomposites and to propose nanoparticulate/nanofabrics/nanofibre phases that could be tested. These could include carbon nanostructures, metallic or even ceramic nanoparticles and/or related fabrics. The selected nanoparticles and/or fabrics will be purchased and used for reinforcement of the PEEK matrix. The trainee will investigate the selected properties of the obtained nanocomposite materials and compare them with the pristine 3D-printed PEEK. For this purpose the state-of-the-art laboratories of the Materials Space Evaluation & Radiation Effects Section will be available.

The techniques that could be employed to gain direct insight into the nanocomposite microstructure include X-ray diffraction, X-ray tomography or imaging / EDX mapping of thin intersections. In justified cases the trainee will perform quantitative studies to correlate the impact of the nanoparticles amount with the nanocomposite properties. One of the challenges is the control of the nanoparticles sedimentation rate or finding a way to utilize this phenomenon for the specific applications.

Required education:

Applicants should have just completed, or be in their final year of a University course at Masters Level (or equivalent) in a technical or scientific discipline, preferably in materials science/physics/chemistry of materials (or materials engineering) or applied physics. Good understanding of materials analysis techniques, ability to perform experimental work in laboratory, and knowledge of the space environment (vacuum, chemistry, temperature) are strong assets.

Applicants should have good interpersonal and communication skills and should be able to work in a multi-cultural environment, both independently and as part of a team.

Applicants must be fluent in English and/or French, the working languages of the Agency. A good proficiency in English is required.