Training Opportunity for Portuguese Trainees

Reference	Title	Duty Station
PT-2015-TEC-QTM	**Advanced Nano-Materials for Space Applications**	**ESTEC**

Overview of the Unit missions:

The Components Technology and Space Materials Division, within the Product Assurance and Safety Department, primarely covers Materials and Electrical, Electronic and Electromechanical (EEE) components technology and development, reliability assessment and industrialisation. It is responsible for the technical management of materials and components space evaluation, verification and qualification.
The work proposed will be carried out within the Materials Technology Section. The activities performed within the remit of the Materials Technology Section include:

- The qualification for space flight of all advanced metallic materials, structural ceramics and glasses as well all related manufacturing and surface treatment processes for all ESA spacecraft and launchers Programme
- The development of revolutionary materials and innovative manufacturing technologies both internally and in cooperation with other space agencies and organisations
- The failure investigation of materials and processes underperfoming and impacting ESA space missions
- The development, certification and support of new European industrial capabilities, manufacturing processes and manpower skills training related to space applications of materials and components
- The establishment and implementation of requirements and standards for the development and the procurement od space grade materials and manufacturing processes
- The development, maintenance and improvement of the European Space Materials Database, storing all relevant data generated for materials and processes intended for Space use

In order to achieve its objectives, the Materials Technology Section has also direct access to the world leading ESTEC Materials and Electrical Components Laboratory, covering the full spectrum of materials characterisation testing capabilities.

Overview of the field of activity proposed:

The advancement in space technology has been made possible by many specific breakthroughs in materials science, facilitating the development of highly sophisticated spacecraft and launchers systems and enabling highly demanding space missions.

Since their discovery carbon nanotubes (CNTs) have been considered a revolutionary technology in producing advanced polymer, ceramics and metal nanocomposites. The use of CNTs could allow designing new materials with unprecedented flexibility and major improvements in their physical properties including electrical conductivity, thermal conductivity, machinability, and structural performances.

A wide range of space applications have been identified within ESA, including:

- Light truss structure with integrated health monitoring systems
- Light weight optical elements, mirrors and reflectors
- Thermal protection systems and hot structures
- Thermal control elements, heat pipes, heat sinks and improved radiators
- Components for microwaves and antennas

However, challenges are still open and shall be addressed if CNTs doped materials are considered for space use in spacecraft and launchers primary structures: in particular open challenges include control over the distribution in size and dispersion of the nanosized constituents as well as tailoring and understanding of the role of interfaces between structurally or chemically dissimilar phases on bulk properties.

The Materials Technology Section is investigating within different research programme the application of CNTs to all possible materials matrices ranging from metals, ceramics and polymers also in combination with the game changing Additive Layer Manufacturing (ALM) technologies (3D printing).

The proposed activity will cover the following:

- Identification of applications relevant requirements
- Development of CNTs doped Fiber Reinforced Plastics as well as metal/ceramics matrix composites with enhanced functionalities
- Define "made to measure" materials development processes
- Establish/assess industrial manufacturing capabilities as well as relevant verification/qualification routes, also applicable to ALM technologies
- Definition of relevant key performances laboratory testing for each identified application
- Perform the identified testing including but not limited to:
    - Thermo mechanical testing
    - Fatigue and Fracture Mechanics characterisation
    - Metallurgical assessment using state of the art laboratory destructive and non-destructive equipment
    - Corrosion and stress-corrosion testing
    - Electrical and thermal conductivity
    - Space environment effect
    - Non-contact optical 3D deformation measuring systems to document the materials response to the applied solicitation and the relevant failure mechanisms

In the frame of the testing activities the selected candidate will also:

- Issue testing protocols and procedures for the different experimental conditions
- Issue relevant test reports
- Present the achieved results in the form of Power Point presentations to internal and external selected audiences

Required Education:

Candidates should also have hands-on experience in metallurgy, failure analysis and effects of the space environment on metallic as well as non-metallic materials. In addition, applicants should demonstrate a sound knowledge of materials, processes, modelling, and verification- and testing- related aspects for high- end technology domains.

Applicants should have good interpersonal and communication skills. They should have the ability to work autonomously, effectively and cooperatively in a diverse and international team environment and to define and implement solutions in line with team and individual objectives and project deadlines.