Job Title: Internal Research Fellow (PostDoc) in Prediction of contamination effects due outgassing

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EUROPEAN SPACE AGENCY

Research Fellow opportunity in the Directorate of Technology, Engineering and Quality.

ESA is an equal opportunity employer, committed to achieving diversity within the workforce and creating an inclusive working environment. Applications from women are encouraged.

Post

Internal Research Fellow (PostDoc) in Prediction of contamination effects due outgassing

This post is classified F2 on the Coordinated Organisations' salary scale.

Location

ESTEC, Noordwijk, The Netherlands

Description

The Materials Physics & Chemistry Section operates state-of-the-art space simulation facilities (vacuum, temperature, EM and particle radiation, etc.) as well as instruments to characterise physical and chemical properties within the materials and EEE components laboratory. It provides engineering support to all ESA projects and development programmes in the area of materials physics and chemistry, associated processes and environmental effects.

What we do:
• physical analysis and characterisation of materials including phase transitions, thermo-mechanical analysis, thermo-optical analysis, thermal analysis, surface analyses such as electron-based imaging techniques (SEM/EDX/WDX), X-ray techniques such as X-ray tomography and other non-destructive evaluation techniques;
• chemical analysis and characterisation of materials (all types of spectroscopy such as UV-VIS-NIR, GCMS, NMR, FTIR, Raman, thermal analysis, surface analysis such as XPS, EDX,WDX, contact angle);
• cleanliness and contamination control, including lab work focused on contamination monitoring, materials outgassing characterisation, surface analysis and evaluation of contamination impacts on performance;
• environmental evaluation (ground/space effects) including lab testing work and support of non-conformance reviews, requests for approval; this includes evaluation of degradation effects due to (long-term) storage and corrosion, biodegradation, entry/re-entry assessment of physical/chemical processes and other processes;
• performance prediction and verification (incl. in-orbit & post-flight analysis) of materials and associated processes.

Interested candidates are highly encouraged to visit ESA website: www.esa.int

Field(s) of activities/research

Prediction of contamination effects due to outgassing

During exposure to a vacuum, especially at elevated temperature levels, volatile chemicals contained in many spacecraft components (e.g. CFRP panels, adhesives, harness) may over time migrate to the surface via diffusion and escape via desorption. In extreme temperature environments, organic materials even tend to decompose into simpler substances, which may then outgas through desorption or diffusion. The combination of these processes, called outgassing, is then a function of time and temperature.

Outgassed molecules may then condense on cold parts of a spacecraft and build up on sensitive surfaces that can decrease the performance levels of instruments, equipment and in some cases entire subsystems, and may even cause mission failure outright. Evaluating deposited contamination masses on sensitive surfaces is therefore a key task in evaluating spacecraft (and/or instrument) performance loss.
For this purpose, ground testing is needed to assess mass loss and build-up. Since ground tests cannot be run for durations comparable to mission lifetimes, they have to be performed at an accelerated rate. The ESA materials laboratory has a number of dynamic outgassing facilities to measure material mass loss and condensed mass as a function of time and temperature.
As for the outgassing itself, although its chemistry can be fairly complex, the kinetics are well understood, which allows reliable long-term predicting of total mass loss from data obtained in accelerated tests, via a physics-based model (ECSS-Q-TM-70-52A).
On the other hand, the build-up of contamination on a given surface is a complex process dependent on many factors which affect both the incoming flux of molecules from the contamination sources impinging on the target surface and the outgoing flux of molecules from the target surface due to re-emission. Translating accelerated test results into long-term predictions for incoming flux is not a huge challenge. However, when considering the outgoing flux of molecules, things get much more complicated, given that there are no good kinetic models and the chemistry is not well understood. Different approaches have been proposed in the past, none having been considered entirely adequate to date.
This research topic aims at developing a method that would allow reliable use of the results obtained in accelerated tests to calculate long-term predictions for mass build-up on cold surfaces due to material outgassing.
Under this activity, the Research Fellow is required to perform an extensive assessment and evaluation of the dynamic outgassing data that have been collected for over 20 years on a wide variety of materials, lately accompanied by in situ thermos-gravimetric analyses and ex situ GC/MS analyses of the condensed material. The candidate should first investigate the potential of these latter techniques analytically and/or by testing and then compare them with other possible techniques that could have high potential. The incumbent should then identify the most promising technique or set of techniques and on that basis develop, optimise and verify a methodology allowing reliable long-term prediction of contamination build-up, starting with data collected in accelerated tests. The optimisation process will aggregate the mathematical model, the ground test results (test facilities, chambers) with available 3D modelling tools (COMOVA, SYSTEMA, etc.) in order to predict the interaction of space-grade materials with the vacuum/time/temperature environment.

Technical competencies

Ability to conduct research autonomously
Breadth of exposure coming from past and/or current research/activities
Research/publication record
Knowledge relevant to the field of research
General interest in space and space research
Ability to gather and share relevant information

Behavioural competencies

Innovation & Creativity
Continuous Learning
Relationship Management
Self Motivation
Communication
Problem Solving
Cross-Cultural Sensitivity

Education

Applicants should have recently completed, or be close to completing, a PhD in computational physics/chemistry, (mathematical) materials science, applied mathematics. Preference will be given to applications submitted by candidates within five years of being awarded their doctorate.

Additional requirements

Specific requirements:

- good mathematical background
- good knowledge of modelling techniques (mass transfer-related modelling would be an asset)
- ability to interpret experimental results

In addition, applicants should demonstrate good interpersonal skills and the capacity to work both independently and as part of a team. During the interview the candidates' motivation and overall professional perspective/career goals will also be

explored.

The working languages of the Agency are English and French. A good knowledge of one of these is required. Knowledge of another Member State language would be an asset.

Other information

For behavioural competencies expected from ESA staff in general, please refer to the ESA Competency Framework.

The Agency may require applicants to undergo selection tests.

The closing date for applications is 29 January 2019.

In addition to your CV and your motivation letter, please add your proposal of no more than 5 pages outlining your proposed research. Candidates must also arrange for three letters of reference to be sent by e-mail, before the deadline, to temp.htr@esa.int. The letters must be sent by the referees themselves. The candidate's name must be mentioned in the subject of the email.

If you require support with your application due to a disability, please email contact.human.resources@esa.int.

Please note that applications are only considered from nationals of one of the following States: Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, the United Kingdom and Canada and Slovenia as well as Bulgaria, Cyprus, Latvia, Lithuania, Slovakia as European Cooperating States (ECS).
Priority will first be given to candidates from under-represented Member States.
In accordance with the European Space Agency's security procedures and as part of the selection process, successful candidates will be required to undergo basic screening before appointment