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THE FRENCH AEROSPACE LAB

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PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **DPHY-2025-17**
(à rappeler dans toute correspondance)

Lieu : ONERA, CT

Département/Dir./Serv. : DPHY-CSE

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Responsable(s) du stage : Marc Villemant

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DESCRIPTION DU STAGE

Thématique(s) : Plasma material interaction

Type de stage : ☐ Fin d'études bac+5 ☐ Master 2 ☒ Bac+5 ☐ Autres

Intitulé: Characterisation of material degradation under space-used plasma irradiation

Sujet: In the context of space, ionic erosion occurs at multiple locations on a standard satellite. The use of plasma propulsion on satellites, replacing the chemical propulsion, significantly reduces the amount of fuel required to maintain satellite position and altitude control. This technology is being developed as electric propulsion is increasingly used for the positioning of satellites in geostationary orbit. However, the ions composing the plasma can interact with the materials present on the thrusters and the overall spacecraft. This process can then significantly reduce the lifetime of the spacecraft. An additional issue lies on the fact that space industry is struggling to find a replacement for xenon as plasma thruster propellant, since wordwide Xe production is plummeting down and the associated cost soars up. Iodine seems to be one of the most promising propellant to replace Xenon thanks to its high availability and low price, high compacity and ease of use under solid state, low ionization energy, physical properties close to Xenon. The major concern regarding this new solution is linked to the high chemical reactivity and corrosivity of this component which may then strongly interact and degrade the different spacecraft surfaces and alter the function of different systems (optics, solar generators, antennas, …).

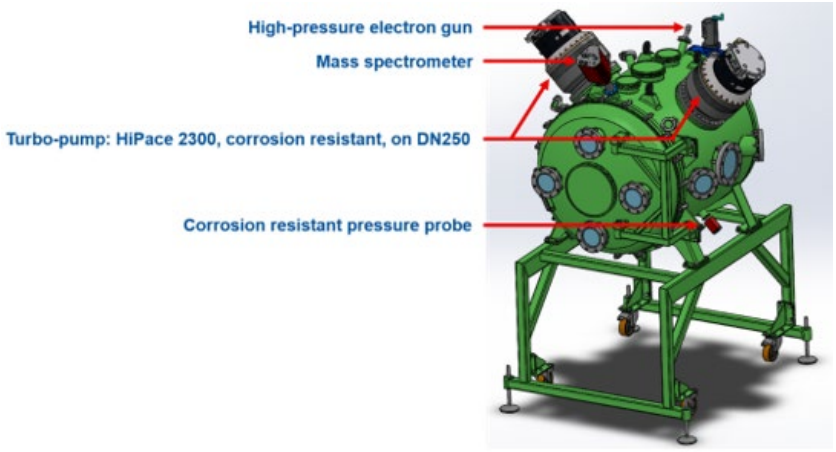

Figure 1 External scheme of PICOMAX-E with equipments

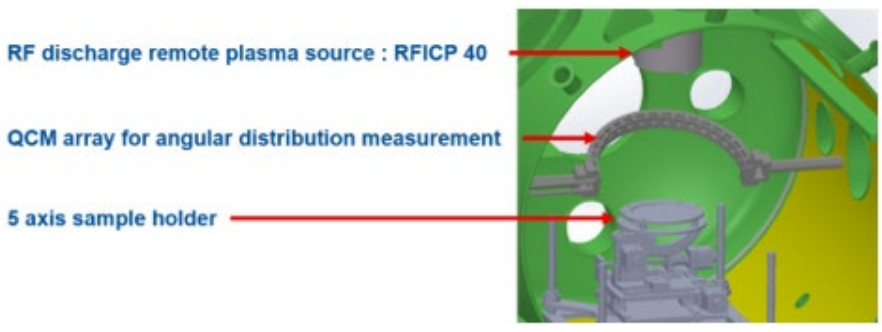

Figure 2 Internal scheme of PICOMAX-E with plasma source and measurement tools.

The student will have the opportunity to operate on a new received experimental set-up called PICOMAX-Erosion, installed at ONERA Toulouse, dedicated to the study of the interaction of a chemically reactive plasma with material specimen. This experimental set-up allows characterizing the impact of reactive plasma (among which iodine is predicted to be thoroughly studied) with materials surface. The student should have the opportunity to use different surface and gas characterization tools available at ONERA: mass spectrometry, XPS, Raman spectroscopy, QCM measurement, FT-IR spectroscopy, …

The objective of this internship is to carry out first measurements of ion sputtering under iodine plasma bombardment. The student will first install the instrumentation dedicated to the measurement of ion sputtering and plasma characterization. The student will then measure iodine ion sputtering on reference materials (aluminium, graphite, steel, etc.) and compare it with available data for other plasma such as Xenon, Krypton and Neon plasma.

We are looking for a student eager to prepare a PhD thesis for three years after this internship. This work will be performed in collaboration with CNES in Toulouse.

Est-il possible d'envisager un travail en binôme ? **Oui**

Méthodes à mettre en œuvre :

☒ Recherche théorique	☐ Travail de synthèse
☒ Recherche appliquée	☐ Travail de documentation
☒ Recherche expérimentale	☐ Participation à une réalisation

Possibilité de prolongation en thèse : **Oui**

Durée du stage : Minimum : 4 mois Maximum : 6 mois

Période souhaitée : Printemps à Automne 2025

PROFIL DU STAGIAIRE

Connaissances et niveau requis :	Ecoles ou établissements souhaités :
Master 2 en physique des matériaux et mesures physiques	Université ou Ecole d'Ingénieur