Emmanuel FLAHAUT
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Référence : 3d9443e67f
Candidature N° : 216
Langue: Français

Etape: Proposition SUJET

1 → Structure/Entité Proposant
Acronyme, libellé (ex : CNES - Centre National d'Etudes Spatiales)

CIRIMAT - Centre Interuniversitaire de Recherche et d'Ingénierie des Matériaux

Dernière modification: 25/10/2022 - 20:41:35 Par: Emmanuel

2 → E-mail Directeur Structure/Entité proposant *

christophe.laurent@univ-tlse3.fr

Dernière modification: 25/10/2022 - 20:42:37 Par: Emmanuel

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4 → Domaine - Thématique

Microgravity, Exploration Sciences

Dernière modification: 25/10/2022 - 20:42:43 Par: Emmanuel

5 → Titre du sujet *
En anglais (72 caractères max)

Nouveaux matériaux antimicrobiens pour l'environnement spatial

Dernière modification: 25/10/2022 - 20:43:15 Par: Emmanuel

6 → Descriptif du sujet *
En anglais (5000 caractères max)

In view of long-duration manned flights, indoor air quality and surface cleanliness is a major issue. Currently, the ISS is known to be populated by numerous microbial organisms, fungi and bacteria growing in a totally enclosed environment including sanitation systems, thermalization circuits subject to condensation, various experiments and human activities. If the presence of a diversity of micro-organisms is not itself problematic, the localised development of organisms in significant amounts may lead to local deterioration of materials (corrosive biofilms) on sensitive surfaces that are difficult to clean, or even to the propagation of micro-organisms in the air, which could prove dangerous for the crew to breathe. Having a passive means of preventing the development of micro-organisms on surfaces will make it possible to better tackle this problem, which will also arise for more distant manned missions such as lunar and Martian missions. This type of equipment could, for example, make it possible to change the cleaning strategy from the systematic and preventive mode currently practised on the ISS to a more flexible strategy giving astronauts greater autonomy by allowing them to act only where necessary. This will not only improve the microbiological conditions of exploration vessels but will also help to break the routine of long-duration trips and therefore make them more bearable. It is in this context that CIRIMAT (and in particular the Nanocomposites and Carbon Nanomaterials (Elaboration, Densification (NNCED) and PPB (Phosphates, Pharmacotechnics, Biomaterials) teams) is proposing the use of carbon nanomaterials (few-layer graphene (FLG), graphene oxide (GO), carbon nanotubes (CNT)) for antimicrobial purposes. Our previous work has demonstrated the antibacterial activity of CNTs in suspension [1], while the work in progress in the framework

of L. Giraud's thesis is focusing on the transfer of these properties to the surface of materials. This work, which has yet to be consolidated, has already evidenced an antibacterial effect on both gram + and gram - bacteria, as well as an antiviral effect (work in progress). The principle developed during this work consists of ensuring the presence of carbonaceous nanomaterials (CNM) at the surface of the treated material, i.e. in direct contact with the pathogens. We have thus developed an approach based on the deposition by spraying of an "ink" on the surface of the material to be treated while ensuring the strong interaction between the CNM and the surface to prevent any unwanted release. As the presence of CNM inside the matrices (case of nanocomposites) is unnecessary (due to the absence of contact with pathogens), this methodology allows to limit the quantities of CNM required by focusing on the interface at the surface [2]. As the antimicrobial effect is related to direct contact with the pathogens without the need for release of the nanomaterials, this effect is envisaged over the long term, without loss of efficacy. However, questions related to the possibility of biofilm formation should not be neglected and are included in this study. In this work, we propose to develop an CNM-containing coating that could be easily deposited on any object to be treated, considering all relevant aspects in the manned space environment: antibacterial, antifungal and antiviral. The bioassays will be carried out in collaboration with IPBS, already a partner in the current work, in collaboration with other labs in Toulouse if necessary. Evidence of the absence of release of CNM will have to be provided, and the CIRIMAT team is one of the recognised specialists in the study of CNM toxicity with respect to both humans and the environment. It is important to mention that the work developed within the frame of this project may also have similar applications on Earth, especially for biomedical devices and surgical tools, but also for example in public transports. Overall, the topic and goals of this thesis are part of the ECLSS (Environmental Control and Life Support System) roadmap of Spaceship France. The work will be done in close collaboration with Gregory Navarro (CNES Toulouse). Cited references: [1] [MyCore] M. Olivi, E. Zanni, G. De Bellis, C. Talora, M. S. Sarto, C. Palleschi, E. Flahaut, M. Monthioux, D. Uccelletti, S. Fiorito, Nanoscale, 5, (2013), 9023–9029, "Inhibition of microbial growth by carbon nanotube networks" [2] [HAL] [MyCore] L. Giraud, A. Tourrette, E. Flahaut, Carbon, 182, (2021), 463-483, "Carbon nanomaterials-based polymer-matrix nanocomposites for antimicrobial applications: a review"

Dernière modification: 28/10/2022 - 11:36:49 Par: Emmanuel

7 → Profil du candidat *

En anglais - Préciser la spécialité du master

We are looking for this work for a student with a Master in microbiology. The PhD co-directors (E. Flahaut, A. Tourrette) have all the required background in Materials Science. Of course, we will look for a student highly interesting to work at the interface between the 2 disciplines (microbiology/materials science) as this PhD project is exactly at the interface.

Dernière modification: 28/10/2022 - 11:09:25 Par: Emmanuel

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9 → Cofinanceur(s) envisagé(s) *

Université Paul Sabatier Toulouse 3

Dernière modification: 28/10/2022 - 11:10:00 Par: Emmanuel

10 → Laboratoire d'accueil envisagé *

Préciser l'acronyme et le libellé (ex : CNES - Centre National d'Etudes Spatiales)

CIRIMAT UMR CNRS-UPS-INPT N°5085

Dernière modification: 28/10/2022 - 11:10:28 Par: Emmanuel

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Dernière modification: 28/10/2022 - 11:10:54 Par: Emmanuel

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Dernière modification: 28/10/2022 - 11:11:13 Par: Emmanuel

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Si non connu, indiquer le nom d'une des personnes mentionnées dans l'onglet Contacts

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Dernière modification: 28/10/2022 - 11:11:52 Par: Emmanuel

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Dernière modification: 28/10/2022 - 11:12:03 Par: Emmanuel

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Dernière modification: 28/10/2022 - 11:12:16 Par: Emmanuel

16 → Commentaire

Thèse co-dirigée avec le Dr Audrey Tourrette

Dernière modification: 28/10/2022 - 11:13:06 Par: Emmanuel

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Tous les champs marqués d'une étoile doivent être renseignés afin que la proposition soit considérée comme complète