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Microbial biofilms in space – Evaluating copper-based antimicrobial surfaces in the upcoming ESA space experiment BIOFILMS

Katharina Siems[1,*], Daniel Müller[2], Frank Mücklich[2], Elisabeth Grohmann[3], Rocco L. Mancinelli[4], Jutta Krause[5], Rene Demets[5], Nicol Caplin[5], Andrea Koehler[5], Alessandra Tortora[6], Ruth Hemmersbach[1], Christine E. Hellweg[1], and **Ralf Moeller**[1*]

[1] German Aerospace Center (DLR), Institute of Aerospace Medicine, Cologne, Germany
[2] Department of Materials Science and Engineering, Saarland University, Saarbrücken, Germany
[3] Beuth Hochschule für Technik, Fachbereich Life Sciences and Technologie, Berlin, Germany
[4] NASA Ames Research Center / Bay Area Environmental Research Institute, CA, USA
[5] ESA, European Space Research and Technology Centre (ESTEC), Noordwijk, Netherlands
[6] Kayser Italia Srl, Livorno, Italy

* presenting authors: ralf.moeller[at]dlr.de, katharina.siems[at]dlr.de

Abstract

An enduring human presence in space is required to achieve many goals of ESA´s and NASA´s space programs. During long-term missions, astronauts are exposed to various conditions such as microgravity, radiation, sleep-disruption, insufficient nutrition and also microbial contamination. Since astronauts´ immune function is compromised, all these factors increase the health risk for the crew. Therefore, improved spaceflight-suitable methods for microbiological monitoring, hygiene and decontamination are important.
Microbial biofilms are of particular concern in spaceflight, because they cannot only cause damage to equipment but also be a risk for human health. Certain metals have antimicrobial properties such as copper and its respective alloys and therefore, prevent the formation of biofilms. However, precise evaluation of suitable antimicrobial materials for space flight is essential.
Within the ESA project BIOFILMS ("Biofilm Inhibition on Flight equipment and on board the ISS using microbiologically Lethal Metal Surfaces"), effects of microgravity on biofilm formation on tailor-made nanostructured metallic surfaces are going to be examined. For that, human-associated microorganisms and antimicrobial surfaces with different chemical compositions and geometric nanostructures are selected. Experiments will be conducted aboard the ISS, where microbial growth will occur under optimal biofilm inducing conditions inside a particular designed hardware. The selected antimicrobial surfaces are supposed to be tested under different spaceflight-relevant gravitational regimes.
Here, preliminary experiments with *Staphylococcus capitis* subsp. *capitis* for the BIOFILMS project will be presented. *S. capitis* forms biofilms and is related to infections such as endocarditis, urinary tract infections and catheter induced bacteremia. The reduction of growth and biofilm formation under the influence of copper-based, nanostructured surfaces was investigated.