

Cold plasma-based disinfection technology as a sustainable alternative

terraplasma and TUM develop prototype of a mobile cleaning robot with plasma-activated mist with "CAPbot"

Munich, May 13, 2025 – As part of an interdisciplinary research project called "CAPbot", terraplasma GmbH and the Chair of Medical Technology Materials and Implants at the Technical University of Munich (TUM) will develop a novel platform technology for soil-based disinfection. The aim is to integrate a cold plasma source into an automated mopping robot system for use in highly sensitive environments such as clinics, food processing, pharmaceutical and cosmetics industries as well as public facilities.

Background: Chemical-free disinfection as part of the green economy

In view of the EU's **Chemicals Strategy for Sustainability** (CSS) and the associated demand for a reduced use of environmentally harmful substances, alternative disinfection methods are becoming increasingly important. Conventional chemical disinfectants – including biocides such as triclosan – are not only associated with risks to the environment and water but also promote the development of resistance of pathogenic microorganisms.

The developed technology therefore specifically relies on plasma-activated fog – a mixture of reactive species generated by the combination of cold atmospheric plasma (CAP) and microfine water mist. This method enables a material-friendly, residue-free and effective inactivation of microbial contamination – without the use of classic chemicals.

Technological approach: Plasma mist in automated use

The principles for generating plasma mist developed as part of a previous DBU project in 2024 will now be transferred to a mobile robot platform. Preliminary tests showed that the plasma-water mist combination can achieve a bacterial germ reduction of up to 5 log levels (99.999%) in just 5–10 seconds – without significant material degradation.

Of scientific relevance is the fact that the plasma species are effective not only against bacteria, but also against viruses and fungi – with a very low probability of resistance formation, as observed with chemical biocides.

The cleaning robot has a modular design as a prototype and combines navigation intelligence with adaptive dosing of the plasma mist. The solution is scalable and conceivable for larger areas on an industrial scale in the future.

Outlook: Plasma application in hygiene-critical environments

"Our research shows that plasma-activated mist is not only an effective alternative to chemical disinfectants but can also be an important building block for sustainable, safe hygiene concepts," emphasizes Dr. Julia Zimmermann, Managing Director of terraplasma GmbH. "Our approach offers enormous potential, especially in areas with an increased risk of infection and at the same time sustainability claims."

The findings of the project will then be transferred to further development steps, field tests and possible product approval.

About terrapiasma

Founded in 2011 as a spin-off of the Max Plank Society, terrapiasma GmbH, based in Garching near Munich, offers innovative solutions and technologies for the development of cold plasma products in areas where bacteria, fungi, viruses, spores, allergens and odor molecules need to be inactivated efficiently and sustainably, or harmful molecules cause problems. Cold plasmas are partially ionized gases that can replace conventional chemicals or other technologies such as UV, heat or radiation in more and more applications due to their high effectiveness.

With its proven basic technologies, the plasma pioneers of terrapiasma work together with well-known companies from the fields of medical technology, hygiene, water treatment, odor management, air purification, cosmetics and surface modification, among others. It is terrapiasma's goal to further develop and market its environmentally friendly cold plasma solutions together with these partners from industry. A young team that works with a lot of creativity and sophistication, extensive know-how in the fields of cold plasma research and technology as well as over 60 patent patents worldwide support the GreenTech company on its road to success.

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Press image 1: CAPbot - Prototype of a mobile cleaning robot with plasma-activated fog



Press image 2: CAPbot - Prototype of a mobile cleaning robot with plasma-activated mist



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