French Polytech network form for PhD Research Grants from the China Scholarship Council

This document describes one of the PhD subjects proposed by the French Polytech network. The network is composed of 15 engineering schools/universities. The document also provides information about the supervisor. Please contact the PhD supervisor by email for further information regarding your application.

Supervisor information	
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University name	Université Côte d'azur
Country	France

PhD information	
Title	**Bioinspired water harvesting for a sustainable development**
Main topics regards to CSC list (3 topics at maximum)	II. 6 Prevention and treatment of drought IV. 7. Materials for environment and ecology

	VI. 3. Sustainable development engineering
Required skills in science and engineering	Material science, organic chemistry, Surface engineering, Surface functionalisation, 3D modelization, 3D printing, wettability evaluation.

Subject description (two pages maximum including biblio)

Context and project

The climatic changes that our planet is undergoing are no longer debatable today. The climatic extremes encountered season after season leave no room for doubt. Even recently, the multiple and intense periods of heat waves observed in the summer of 2022 are good examples of this. This upheaval must of course lead to a reflection on our way of life and production, but it must also encourage us to reflect in depth on our capacity for remediation to mitigate the consequences. One of these consequences is water scarcity. This summer (2022), many restrictions on the use of water have been put in place at the risk of penalizing crops and leading to a possible scarcity of foodstuffs or even shortages. To limit this type of problem, it is important to be able to diversify the population's water supply sources to reduce its reliance on the sources usually used.

To deal with this situation, remedial technologies have been developed. One of the most widely used responses today is the desalination of seawater. This method has proven its worth in various Gulf countries (Saudi Arabia, Bahrain, Kuwait or United Arab Emirates). However, it has serious limitations. The first is that this technique requires the proximity of a sea or an ocean. The second is the large quantity of salt produced which disturbs or even destroys the nearby environment (salt desert, hypersaline sea)[1–4]. To bring a lasting remediation to the problem of water supply, more sustainable approaches must be found.

A promising alternative is to observe nature to identify the methods that plants and animals use to meet their water needs. One of the strategies observed in nature is the capture of atmospheric water (fog and/or dew) (Figure 1).[5–7]

Figure 1. Examples of water capture from nature. A. Cactus example, B. Insect example and C. Spider web example.

This original, low cost and sustainable method has been transposed for water supply on a human scale. It is notably used in Chile to supply crops in arid zones. Although very inexpensive, this method still has limitations. One of these limitations is its low yield, with a capture rate of around 10%. A second limitation is the low quality of the collected water which remains unfit for human consumption. In order to mitigate these limitations, G. Godeau's team took an interest in the study of plants growing in an arid environment whose surface properties are a source of inspiration.[8] In this project, the team of Dr. G. Godeau proposes the study of plant models to optimize the properties of water capture and make it a viable and abundant source of water supply.

The objective of this research project is to reproduce the surface properties observed in living things to promote interactions with water to combine them with the tools currently used for water capture (Figure 2). The final objective will therefore be to optimize yields and the quality of water capture. The model initially studied in this project is Echeveria pulvinata. Indeed Dr. Guilhem Godeau was able to demonstrate that the surface properties of this plant were favorable to the interaction and collection of water. The purpose of this project is therefore to develop artificial structures offering greater water capture efficiency.

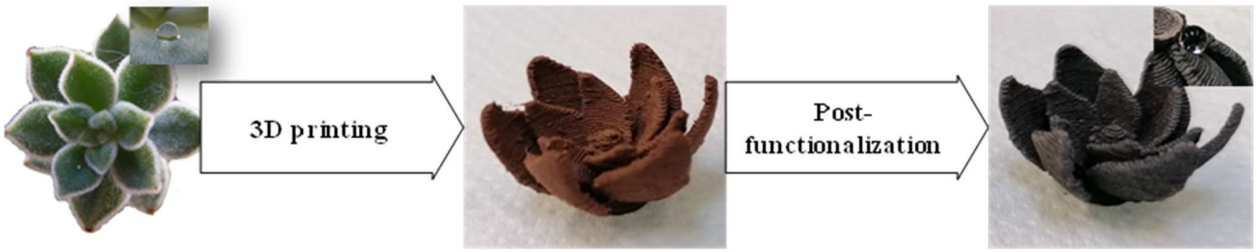

Figure 2. General concept of the project

This project will be carried through three steps:
a. Design, development, and functionalization of artificial surfaces
b. Evaluation of water collection properties
c. Prototype elaboration based on developed surfaces

Presentation of the project leader

This research project is led by Guilhem Godeau Ph. D. at the University Côte d'Azur (UCA). G. Godeau is a member of the Magnetorheology and Nanomaterials team at the Nice Physics Institute (INPHYNI, UMR 7010).
G. Godeau (ORCID numbers: 0000-0002-2111-9858) is an expert in materials science and more particularly in the fields of surface functionalization and wettability. In particular, he participated in the writing of more than 68 scientific articles in international peer-reviewed journals.
In recent years, Guilhem Godeau wanted to take advantage of his personal knowledge of living species (plants and animals) to propose a new line of research within his research team. Since 2017, G. Godeau has offered an original approach inspired by the living world for the study of natural materials and the development of environmentally friendly technologies. [9–12]

References

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