Hybrid photocatalysts for water decontamination and bioethanol production: Circular economy

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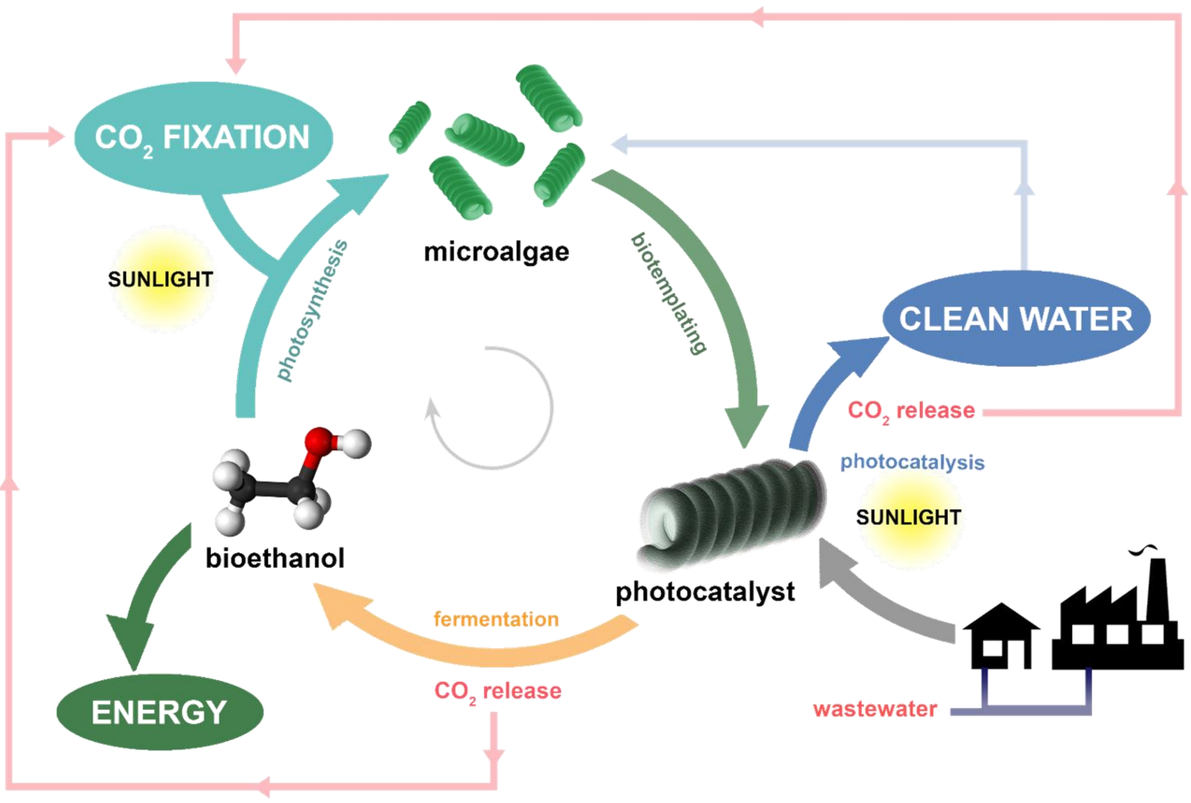
Energy generation and water decontamination are priority goals of our society that exceed local, national, or state interests because of their extremely harmful effects on the environment and human health. This adverse situation is further aggravated in developing countries by the rapid industrialization, which, in general, leads to increasing energy demands and lenient pollution regulations that can worsen the contamination issues. This global context forces the development of new strategies and technologies, characterized by simplicity, sustainability, and low cost, that can be easily implemented worldwide, even in developing countries. It is evident that solar light, and consequently, photochemistry is one of the most promising solutions to alleviate environmental and energy problems.



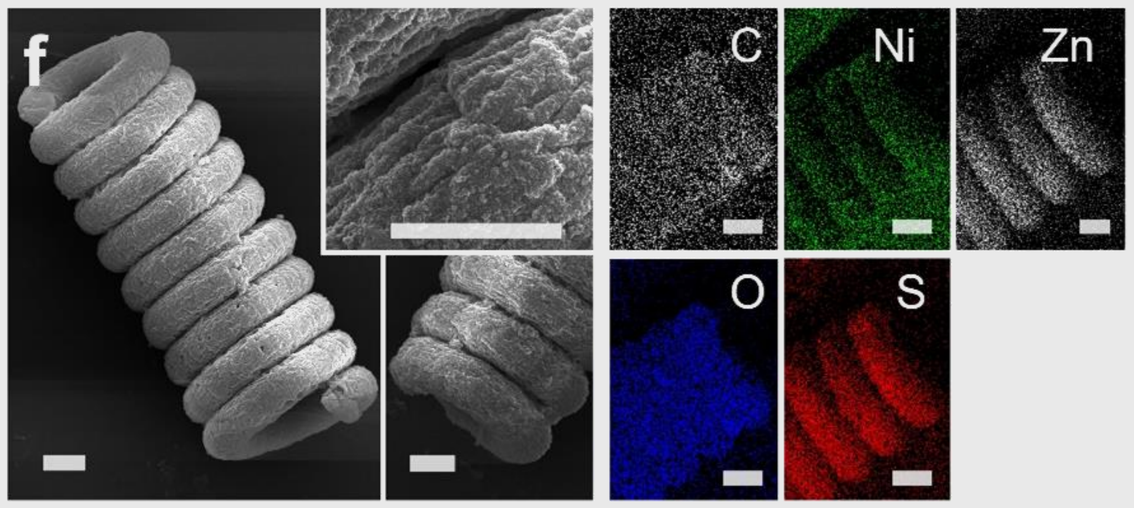
Herein, by exploiting solar light and microalgae, **we have developed a holistic, green, circular, scalable and inexpensive process** that enables integrating carbon dioxide fixation, water decontamination and bioethanol production.

We first use *Spirulina* microalgae for CO_2 fixation and as skeletons to synthesize effective Ni@ZnO@ZnS visible-light photocatalysts with excellent photocatalytic activity for water decontamination with minimal environmental impact. At the end of the photocatalyst lifetime, the hybrid structures are recycled to produce bioethanol by a new simultaneous saccharification and fermentation of the algae biomass.

This integrated strategy could be easily integrated in industrial processes to simultaneously tackle the reduction of CO_2 emission, water purification and energy harvesting.

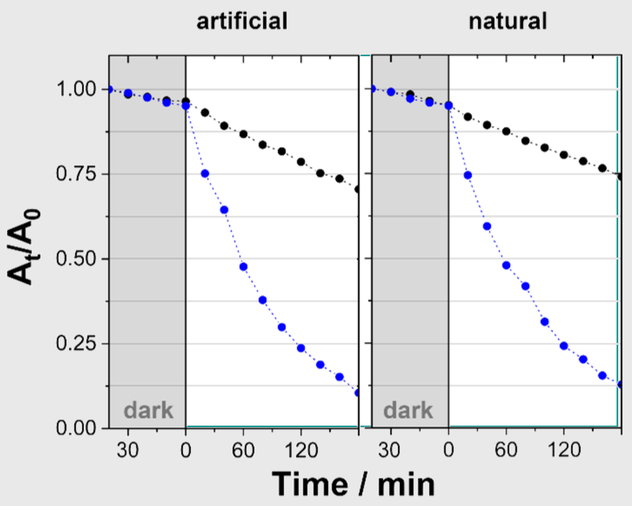
Biotemplating

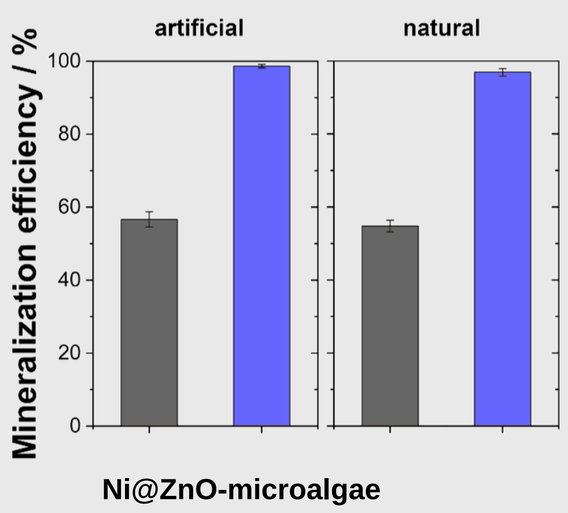
Ni@ZnO@ZnS-microalgae photocatalyst



Scale bars: 5 µm

Photocatalytic water decontamination

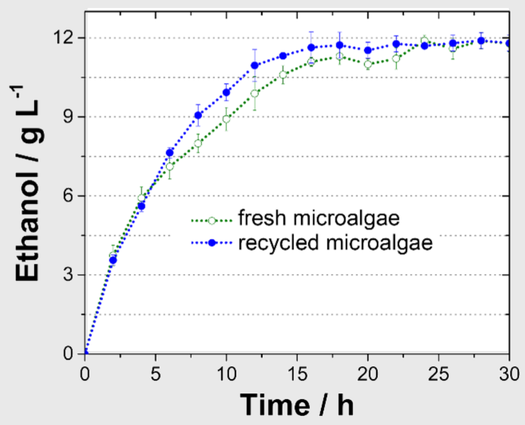




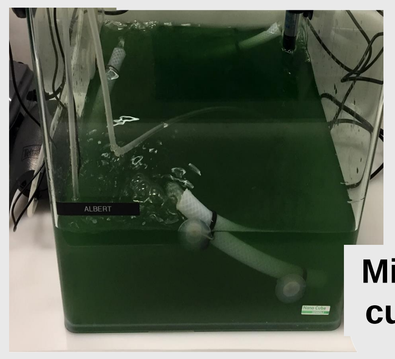
Ni@ZnO-microalgae

Ni@ZnO@ZnS-microalgae

Ethanol production



CO_2 fixation



Microalgae cultivation

References

A. Serrà, R. Artal, J. García-Amorós, E. Gómez, B. Sepúlveda, J. Nogués and L. Philippe, Advanced Science, **2019**, 1902447

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