Biomimetic Synthesis of Lepidocrocite on Marine Spongin Scaffolds: Mechanistic Insights and Multifunctional Potential

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Introduction

In 1968[1], a significant milestone in marine biomineralogy was achieved through the observation of crystalline lepidocrocite mineral phases (γ-FeOOH) forming on the proteinaceous spongin fibers of marine demosponges. This finding laid the foundation for exploring the field of biomimetics, raising intriguing questions about the potential of marine sponges as a sustainable source of unique spongin-based 3D scaffolds suitable for the *in vitro* biomineralization of iron ions on and within their microporous surfaces[2].

Methods

Our recent advancements have employed cutting-edge biomimetic techniques to synthesize lepidocrocite in vitro on a spongin scaffold [3]. This research explores the complex interaction between iron ions and the spongin scaffold in an artificial seawater environment, resulting in the development of a centimeter-large 3D Iron-Spongin composite. It has been analyzed using analytical techniques, including digital optical microscopy, scanning electron microscopy (SEM/EDX), high-resolution transmission electron microscopy (HRTEM), FTIR, X-ray diffraction, and confocal micro X-ray fluorescence spectroscopy (CMXRF).

Results

Our findings suggest a plausible mechanism for lepidocrocite formation, potentially linked to the amino acid functional groups present in spongin. Beyond its fundamental insights, this research has successfully introduced the application of this 3D composite construct as dopamine sensors, marking a novel achievement in the field.

Conclusions

Consequently, this work not only elucidates the mechanisms and sensing capabilities of Iron-Spongin composite but also underscores its potential as a versatile, renewable material for a variety of applications, including sensors, catalysts, and pollutant adsorbents.

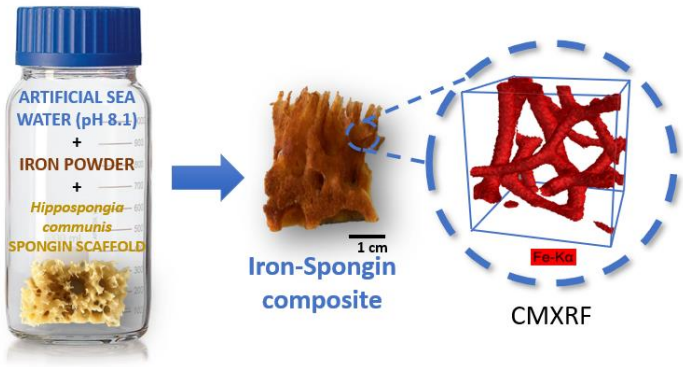

Figure 1: Schematic illustration of the preparation of Iron-Spongin for the study.

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