Tytuł projektu

Metaboliczne domieszkowanie jonami lantanowców (cer, terb) biokrzemionki okrzemkowej w trakcie hodowli wybranych gatunków okrzemek w warunkach laboratoryjnych.

Project title

***Metabolic inserting of lanthanide ions (cerium, terbium) in diatom biosilica by cultivation of selected diatom species under laboratory conditions*.**

Dyscyplina /Area of science

Nauki chemiczne

PROJECT DESCRIPTION

Project goals

The overall objective of the project is the biosynthesis of 3D diatom biosilica with openwork three-dimensional structure doped with lanthanide ions (cerium, terbium) during cultivation the selected species of diatoms under laboratory conditions and detailed characterization of the obtained biosilica: morphological and structural features, elemental composition, surface area and pore structure, photoluminescence properties, structural bonds and thermal stability as well as the specifics of the distribution of the lanthanide ions in the biosilica structure.

Outline

In the development of modern technologies, especially in the design and manufacture of new nanocomposite inorganic materials, microorganisms and in particular unicellular algae (microalgae) are the growing inspiration due to their abundance and unique properties. They are treated as “microfactories” in the biosynthesis of biomaterials. The intricately ornamented silica shells known as frustules with three-dimensional (3D) structure that can be used for the needs of nanotechnology are offered by unicellular diatoms. The siliceous walls of diatom frustules are perforated by periodic arrays of pores with diameters ranging from nano to micro scale with forming unique openwork three-dimensional silica structures. Opportunities of biosynthesis of 3D structured silica by growing diatoms can also significantly extend to the chemical modification of diatoms in the growing process (metabolic insertion). The unique natural structure of diatom frustules can be also used as a template, either to coat it with other substances, or to replace the silicon of other elements.

The proposal of incorporating selected elements in diatom biosilica is based on known the possibility of entering these elements as admixtures in the structure of silica and silicate minerals as well as the opportunities of diatom cells to metabolic inserts of the different metals in their silica frustules. The doping of diatom exoskeletons by selected

active chemical elements will be carried out during diatoms growing by manipulating culture conditions, medium composition and concentration of doped elements.

Lanthanide ions are an interesting class of dopants (vitamins of modern industry) that possess unique optical and magnetic properties associated with their *f*-electronic configurations. Demand for rare earths has surged in the past decade due to their importance in hi-tech applications. Silica doped with lanthanide ions is a visible/near-IR optically active material widely used for photonic applications, including lasers and optical amplifiers and has significant potential for use in optical devices such as microlasers, thin-film device structures, active photonic band gap materials concentration of lanthanide ions has significant potential for use in optical devices, and luminescent markers or nanosensors.

Work plan

1. Biosynthesis of the diatom biosilica by the controlled cultivation of selected diatom species depending on the culture conditions (long-term cultivation, concentration Si, N, P in culture medium, pH, aeration, light regime) without the presence of the modifier elements (Tb, Ce) in the culture medium.
2. The study of physicochemical properties of produced diatom biosilica (morphological and structural features, elemental composition, crystal structure, pore structure, the nature and stability of structural bonds, and photoluminescence properties) using a number of instrumental methods (FTIR, UV-Vis, XRD, TGA, NMR, TOC, SEM, TEM, AFM, ICP/MS, spectrofluorometry, porosimetry).
3. Biosynthesis of the biosilica by the controlled cultivation of selected types of diatoms depending on the culture conditions with the addition of selected modifier elements (Tb, Ce) to the culture medium.
4. The study of physicochemical properties of produced diatom biosilica metabolically doped with lanthanide ions (cerium, terbium) using a number of instrumental methods.

Literature

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Required initial knowledge and skills of the PhD candidate

- Excellent M.Sc. in chemistry
- Analytical thinking
- Strong and healthy ambition to discover
- Good speaking/writing English skills
- Understanding of basic physics and biology/biotechnology
- Knowledge of physical chemical methods of analyses (e.g. FTIR, UV-Vis, XRD, TGA, NMR, SEM, TEM, AFM, ICP/MS, spectrofluorometry, porosimetry)
- Eager to work hard

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