Recycling Campus Waste Glass Using a Microwave-Assisted Sol–Gel Method for Heavy Metal Sensing and Wastewater Treatment Applications

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Abstract

Recycling glass waste generated in university laboratories represents an important area of research in sustainable resource management and circular economy practices. In particular, recycling borosilicate laboratory glass can not only reduce waste generation but also enable the development of value-added materials.

This project aims to convert waste borosilicate (Pyrex) glass generated in university laboratories into silica-based quantum dots (Si-QDs) using a microwave-assisted sol–gel method.

The proposed synthesis approach involves using organic waste from the campus for surface passivation. By incorporating different types of waste into the same production process, the project aims to establish a materials development approach based on circular economy principles.

The use of the microwave-assisted sol–gel method is intended to reduce synthesis time and energy consumption. By exploiting the ionic trapping properties of the pores in the resulting silica-based nanomaterials, the project aims to develop preconcentration techniques and surface-sensitised electrochemical sensor kits for detecting toxic heavy metals in laboratory wastewater.

The project brings together several sustainability objectives, including converting laboratory waste into high-value nanotechnological products, developing energy-efficient synthesis methods, and monitoring water pollution.

The expected outcomes include the development of a synthesis approach for recycling waste glass and an investigation of the potential applications of the resulting nanomaterials in environmental sensing and wastewater treatment.

Keywords: Waste glass, circular economy, sol–gel method, silica quantum dots, heavy metal sensors.

MİDUG Thematic Area: WP3 – Living Laboratories, Circular Economy, and Youth.