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Greener approach to prepare electrospun antibacterial β-cyclodextrin-based nanofibers for removal of bacteria from water

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Statement of the Problem: Water in Southern Africa is becoming a lot scarcer and the quality can be poor, especially in rural communities where there is no access to purified tap water. As a result, the impact of water-borne diseases is significant. The lack of water has resulted into conflicts and protests in some communities. Groundwater from boreholes and wells plays an important role in water supply, but due to limited hydrological knowledge, these drinking water sources are not always well-designed and they are prone to contamination. Poor sanitation is another problem; e.g. it is well-known that nearby located latrines can result in fecal (and thus pathogenic) contamination of open wells and boreholes. The aim of this project was to develop viable sustainable solutions that involved the integration of nanofibers to a filtration system.

Methodology & Theoretical Orientation: Electrospun nanofibres containing Ag+/Fe3+ ions were subjected to UV-reduction in the presence of water vapor created in a unique system under inert atmosphere at temperatures below 100°C to reduce the ions to zero-valent state, thus avoiding the use of other toxic reducing agents such as ammonia.

Findings: The average diameter of the β-CD-based nanofibers was 382.12±30.09 nm and that the diameters of Ag and Ag/Fe NPs were 38.81±8.21 nm and 56.29±12.64 nm, respectively, after reduction. The effect of UV irradiation time on the reduction of the Ag+ and Fe3+ was studied by measuring the UV–vis absorbance of the reduced NPs. The Ag and Ag/Fe NPs embedded on the β-CD-based nanofibers exhibited a strong biocidal effect on all of the bacteria strains.

Conclusion & Significance: The nanofibers were also tested on real water samples and were found to be effective in killing bacteria in the water.

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Efficient and selective palladium-catalyzed telomerization of 1,3-butadiene with carbon dioxide

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The sustainable approaches for the synthesis of value-added fine and bulk chemicals using viable raw materials and feed stock has been accepted as a collective knowledge by our society. From the aspect of organic syntheses, the development of chemical reactions, with high atom efficiency is the main targets. In this respect, carbon dioxide is considered as a valuable C1 building block due to its abundance, low toxicity and recyclability. To create essential C-C bonds from CO_2 using traditional synthetic methodologies, the use of strong carbon nucleophiles is necessary, which also generate stoichiometric amounts of by-products. In contrast, the catalytic telomerization of 1,3-butadiene with carbon dioxide leads to the unsaturated δ-lactone (3-ethylidene-6-vinyltetrahydro-2H-pyran-2-one) under mild conditions in a 100% atom-efficient manner. Herein, we report our finding on improved palladium catalyst systems for the telomerization of 1,3-butadiene with carbon dioxide and also report the first related reactions with 1,2-butadiene.

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