Name(s)
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Project Number
S1601

Project Title
Knock Your Socks Off: Developing Nanocomposites from Socks for Versatile Water Disinfection

Abstract

Objectives/Goals
Water borne illnesses continue to proliferate in developing countries and areas without reliable water infrastructures. Many emerging materials have fallen short of practical criteria for water treatment because they are expensive, require special resources, or are not developed in an "eco-friendly" manner. My research aims to develop a filter that could disinfect water effectively using relatively common materials and a simple development process.

Methods/Materials
Recycled cotton antimicrobial socks were utilized, which commonly use nanosilver to inhibit bacterial growth in limited amounts. These relatively cheap cotton socks were paired with a coating of Reduced Graphene Oxide for synergistic improvement of antimicrobial effectiveness and increased long-term use. Graphene Oxide was developed using a modified Hummers' Method (from Graphite) and immobilized it onto cotton fabric by a dip-dry process. Then, the rGO was fixed onto the cotton textile by heating to 160 Celsius for 15 minutes. The antimicrobial properties of 3 concentrations of textile were evaluated using untreated water samples from San Joaquin River. Samples were treated at increments of 1, 5, and 10 minutes of immersion of the material. The percent reduction in the Most Probable Number (MPN) of total coliform per 100ml was evaluated based on two samples before and after each run. Silver leaching was also analyzed by measuring silver in ppb in water samples before and after each run. Control samples of the water were also evaluated for total metals (by ICP-MS analysis) and total coliform to corroborate the data.

Results
In a proof of concept run, nanosilver decorated rGO composite had a higher inactivation of total coliform than nanosilver in isolation. Overall, the material showed promising antimicrobial efficacy around log 1 to log 2 reductions in total coliform. At the highest concentration interval for 10 minutes, the material achieved >97% bacterial inactivation. Silver leaching was below the detectable limit of .53 ppb, and is safe by EPA secondary drinking water standards.

Conclusions/Discussion
This material has shown promising effectiveness in bacterial disinfection in water and has possible applications in easy emergency water treatment in areas of high need.

Summary Statement
I made socks that are coated with a composite of nanomaterials that safely and effectively disinfects bacteria in water

Help Received
I researched, planned, performed background work (e.g. sampling), and perfromed the experiment myself. I received some help from AAPL and BSK Labs in Fresno for the analysis of metals and total coliform.