

# BIOENGINEERING, EDUCATION, ENVIRONMENT, MATERIALS & SENSORS FRONTIERS



**Debora Rodrigues**

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Dr. Rodrigues' personal and professional interests are directly related to the water-energy nexus. She has been conducting research to develop new alternative and clean bio- and nano-technologies to reduce energy costs in water and wastewater treatment, that typically account for about 40 percent of the total energy consumed in municipalities. Her research integrates bio-inspired polymer nanocomposites and biological treatments to remove traditional and emerging water contaminants. Some of her technologies aim to produce clean alternative sources of energy, i.e. biofuels; other to recycle essential nutrients in contaminated water for reuse in agriculture. Dr. Rodrigues is the recipient of several national awards, including the National Science Foundation CAREER Award, the U.S. Dept. of Energy 2016 C3E Research Award in the area of the water-energy nexus, the Environmental Award honoree for the 28th HENAC Conference, and the Award for Excellence in Research, Scholarship, and Creative Activity for the 2019-2020 academic year from UH.

## WATER TREATMENT TECHNOLOGIES

### Publications

1. Ansari, A.; Peña-Bahamonde, J.; Fanourakis, S.K.; Hu, Y.; Rodrigues, D.F. 2020. Microbially-induced mineral scaling in desalination conditions: Mechanisms and effects of commercial antiscalants. *Water Research*. 115863.

2. Fanourakis, S.K.; Peña-Bahamonde, J.; Bandara, P.C.; Rodrigues, D.F. 2020. The Use of Nano-based Adsorbents and Photocatalysts for the Removal of Pharmaceutical Contaminants During Indirect Potable Water Reuse. *npj Clean Water* 3 (1), 1-15.

3. Bandara, P.C.; Nadres, E.T.; Rodrigues, D.F. 2019. Use of response surface methodology to develop and optimize the composition of a chitosan-polyethyleneimine-graphene oxide nanocomposite membrane coating to more effectively remove Cr(VI) and Cu(II) from water. *ACS Applied materials @ Interfaces*. DOI: 10.1021/acsami.9b03601.

### Patent Applications

1. US Patent Application No. 16/426,295; Porous nanocomposite polymer hydrogels for water treatment.

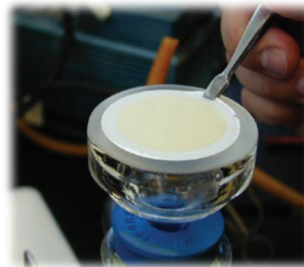
2. WO Patent 2013/039895 A1; Nanocomposite PVK-graphene based nanomaterial filters for the simultaneous removal of bacteria and heavy metal.

Nanotechnology has the potential to create new materials and devices with wide-ranging applications in medicine, electronics, and energy production. Carbon-based nanomaterials, such as single-walled carbon nanotubes, graphene, and graphene oxide, have unique antimicrobial, physical, chemical, electrical, optical and mechanical properties that make them very valuable materials for materials science, high-energy physics, and for a wide range of technological applications, such as biosensing, solar cells, and bioelectronics. Besides using the pure form of carbon-based nanomaterials, there has also been an increased interest in combining these carbon-based nanomaterials with industrial polymer and resin coatings and using this combination for barrier protection, as thin films for biosensors and biomedical devices, in semiconductor packaging, as anti-corrosion coatings, in hospital equipment, and in food packaging. This combination results in products that have improved antimicrobial performance and new properties that lower life-cycle cost, and allow design flexibility and applicability for large-scale fabrication, which is not observed when the constituents of this combination are used individually. Dr. Rodrigues' research group has been successfully incorporating carbon-based nanomaterials (e.g. graphene, graphene oxide, and single-walled carbon nanotubes) into polymers to develop advanced functional materials for different environmental engineering applications, such as water treatment, anti-fouling and anti-corrosion coatings. More recently, she has been developing magnetic nanoparticles with photocatalytic activity for the removal of emerging contaminants.

### Biological Treatment



### Membrane Modifications



### Polymer Nanocomposites

