Siemens Competition
Math : Science : Technology
National Finalist

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Project Title: *Natural, Cost-Effective Anodes for Optimized Sediment Microbial Fuel Cells: Engineering a Novel Approach to Harvesting Energy and Cleaning Up Oil-Polluted Regions*

To address clean energy and pollution issue, microbial fuel cells (MFCs) were hypothesized to simultaneously generate electricity and remediate oil spill pollution. The purpose of this study was to engineer efficient, cost-effective MFC anodes that optimize electrical output and oil remediation using structural and surface coating configurations. For structure, carbonized *Luffa aegyptiaca*, loofah sponges (LS), were tested as cheaper 3-dimensional (3D) alternatives to commercial materials (carbon fiber and RVC). For surface coating, hybrids were synthesized to increase electrical properties. Coatings were uncoated, TiO^2, graphene, and graphene/TiO^2 composite. Nine anode designs were made from these structure/coating combinations. MFCs were implemented in different conditions to assess oil remediation. A multimeter measured electrical outputs; UV-VIS spectroscopy measured oil degradation. Results showed anodes improved oil degradation. LS-structure groups had significantly higher power densities than standard 2D and 3D anodes. LS-graphene/TiO_2 had the highest power density (2087.1 mW/m^2) and oil remediated (93%). This suggests structure and surface coating synergistically improve surface area, biocompatibility, and electrical conductivity for optimized MFC performance. LS are over 90% cheaper than RVC and come from accessible, sustainable sources. This MFC design shows potential towards remediating oil spills and providing clean energy for industries, remote sensors, and developing nations.