Name(s)

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Project Number

S1115

Project Title

Conductive Materials Based Reusable Electrostatic Particulate Matter 2.5 Filters

Abstract

Objectives

Two main aspects of a particulate matter 2.5 µm (PM 2.5) filter were examined for their impact on filtration (i) presence of static electricity and (ii) pore diameters. Five different kinds of materials were tested for filtration efficiency based on the variety of their conductive ability and pore sizes with a hypothesis that the novel graphene oxide (GO) and polyaniline (PANi) composite filter will have a high and the best filtration efficiency.

Methods

The experimentation was carried out in a sealable chamber with an accelerating automobile acting as a PM 2.5 producer. The filtration efficiency was derived by comparing the PM 2.5 concentration with and without the use of each filter. To verify the significance static electricity, three other conductive cotton, silk, and rayon filters were prepared and tested with and without applied static electricity. A novel hybrid graphene oxide (GO) and polyaniline (PANi) composite filters were developed and tested for the effect of pore diameters and static electricity. Using the same experimentation method, different thickness of GO/PANi filters (5 µm and 20 µm) were tested. All filters increased in efficiency after static charging.

Results

The cotton filter had an efficiency up to 69.3% uncharged and 78% charged. The rayon filter had an efficiency of up to 85.6% efficiency uncharged and 93% charged. The silk filter had the efficiency static of up to 85.6% and 99.3% uncharged and charged. The GO/PANi (5 µm) had a comparatively lower efficiency of up to 93.7% uncharged and 97% charged. The GO/PANi (20 µm) had the higher efficiency of up to 98.7% without static electricity and 99.7% efficiency with static electricity.

Conclusions

The GO/PANi had a high filtration efficiency with and without the static electricity charging and can be utilized as an effective and practical filter. The results of the experiment prove that the two main aspects of PM 2.5 filtration is highly influential and when combined together can create high efficiency filters. The current price of creating PM 2.5 filters with GO/PANi similar to the one created for the experiment estimates around $5 for 12-15, 1.5 inch diameter filters. Not only do the results demonstrate the high efficiency of the material, but also opens up possibilities for the novel GO/PANi filter to mass produced and sold as a product.

Summary Statement

I created a particulate matter 2.5 micron (harmful air-borne pollutant) filter using a graphene oxide and polyaniline composite hybrid material that had a high filtration efficiency of up to 99.3%.

Help Received

I built the filter and performed experiments testing filtration efficiency. Professor Richard Kaner from the department of chemistry and materials science and engineering at the University of California, Los Angeles and his research team provided the GO/PANi material and ran characterization tests.