

Buzz Kill

Graphene was first isolated in 2004, and has already been explored for many types of protective applications, because it is the strongest, thinnest (only a single atom thick), and most conductive material on earth. Brown University is working on a new application for graphene — a lining fabric, utilizing graphene oxide that can be made into a “nanosheet coating material” as a protection against mosquito bites.

Brown University’s Superfund Research Program, under the direction of Engineering Professor Robert Hurt, began the mosquito repellent graphene project about 18 months ago. At that time, Hurt’s team was in the process of developing a fabric for personal chemical protection. During the research, the team found that graphene-based barrier layers were also breathable, allowing water vapor and perspiration to pass through it, thus providing body-heat management. This led to some brainstorming for other applications.

“While considering other general uses for graphene-lined clothing, an interest in developing alternative fabrics for mosquito-proof protection was mentioned, and we decided to try our graphene-based films,” explains Hurt. “We were surprised that no one had studied mosquito behavior on graphene, and we found no information on how mosquitos would respond to graphene. As



Research team members Cintia Castilho and Munchun Liu prepare graphene-based materials.

graphene researchers, we found this void in scientific literature very motivating, and committed to the first phase of this study.”

The University’s work uses graphene-based films, rather than fibers. In practice, the graphene films are embedded or laminated with polymer films or fiber-based textiles to provide support and prevent direct user contact with the graphene.

“Based on our knowledge, our paper is the first ever study on the fundamental behavior of mosquitoes that land on graphene,” notes Hurt. “However, there is still much more that needs to be done to create and evaluate the actual fabric products.”

Graphene Research & Challenges

The Brown team initially considered and studied two forms of graphene. “Some of our experiments used graphene alone (as a free-standing material, transferred onto the skin), and some in a graphene laminated cheesecloth, which is used to hold the

graphene against the skin,” explains Hurt. “The cheesecloth material also serves as a model for a lightweight fabric that alone would offer little resistance to mosquito biting.”

The team felt they needed to do live insect testing on the human skin in order to evaluate the direct reliability as to how the fabric would behave. To achieve this, the team recruited volunteers willing to risk a few bites from *Aedes aegypti* mosquitoes by placing their arms into a chamber filled with mosquitoes. Mosquito-resistant tests were conducted on both the volunteers’ bare skin and utilizing a thin layer of graphene covering the skin.

Within the chamber, the volunteers’ arms were swarmed and bitten by the mosquitoes. However, those having their arms covered with the graphene-lined fabric didn’t get a single bite.

The most important challenge for researchers studying this technology will be to stabilize the graphene oxide, so that it continues to provide protection when wet. After studying two graphene types — graphene oxide and a “reduced” type of graphene, or “simple graphene,” the graphene oxide proved to be the preferred type, “because it offers breathability. While the simple graphene form was found to protect under all weather conditions, it is NOT breathable, and is therefore less useful. ●

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For more information on Brown University’s research on “Brown University’s Research on Graphene-coated Fabric for Mosquito Bite Protection,” contact Robert Hurt, Director of Brown University’s Superfund Research Program at: robert_hurt@brown.edu, 401-863-2685.

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