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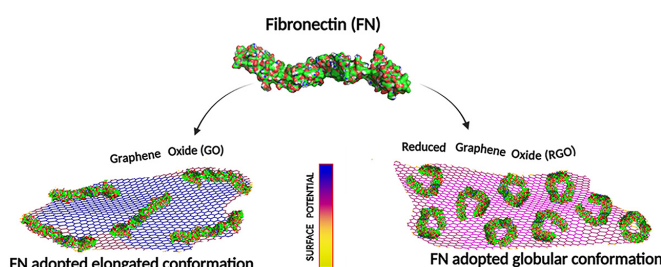
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Putting protein interaction under the microscope to advance tissue engineering and more



Rainwater, when hitting the ground, responds differently according to the characteristics of the terrain. Similarly, protein molecular structures respond uniquely when they interact with the surfaces of biomaterials. In recent decades, the physicochemical surface properties of graphene and graphene-based materials have made them especially promising for tissue engineering applications. While surface chemistry has been extensively studied, relatively little attention has been given to surface potential – an equally critical but often overlooked property.

Rohit et al. examined how material surface potential plays a vital role in protein behavior, comparing two graphene forms: graphene oxide, rich in oxygen-containing groups, and a reduced version called reduced graphene oxide. They found the differences in surface potential dramatically influenced not only how much protein was absorbed but also the molecular shape it developed on the surface.

“How a protein folds or spreads on a surface affects how cells respond to it; how they interact, grow, and differentiate,” said author Sachin Kumar. “So, if we can tune the surface potential of these materials, we could design smarter implants, dressings or scaffolds for intended applications.”

The researchers used Kelvin probe force microscopy, an advanced atomic force microscopy technique, to precisely map the surface potential of graphene films, as well as quartz crystal microbalance with dissipation monitoring to gain insight on molecular conformational changes.

“This study introduces a foundational perspective on biointerfaces to consider surface potential,” said author Rohit Rohit. “We need to consider how a surface, at the molecular level, influences its biological environment as proteins and cells are incredibly sensitive to these subtle cues. This insight will help develop [better] biointerfaces that potentially speed up innovation in regenerative medicine, biosensors, and stem cell therapies.”

Source: “Surface potential modulates fibronectin adsorption and molecular interaction on graphene-based materials,” by Rohit Rohit, Rachayita Bharadwaj, Chandrashish Roy, Sourabh Ghosh, and Sachin Kumar, *Biointerphases* (2025). The article can be accessed at <https://doi.org/10.1116/6.0004504>.

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