

Biocompatible Graphene-based Growth of Cancer Cells: A Work In Progress

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TOPIC

Research Project: Cellular growth via graphene sheets

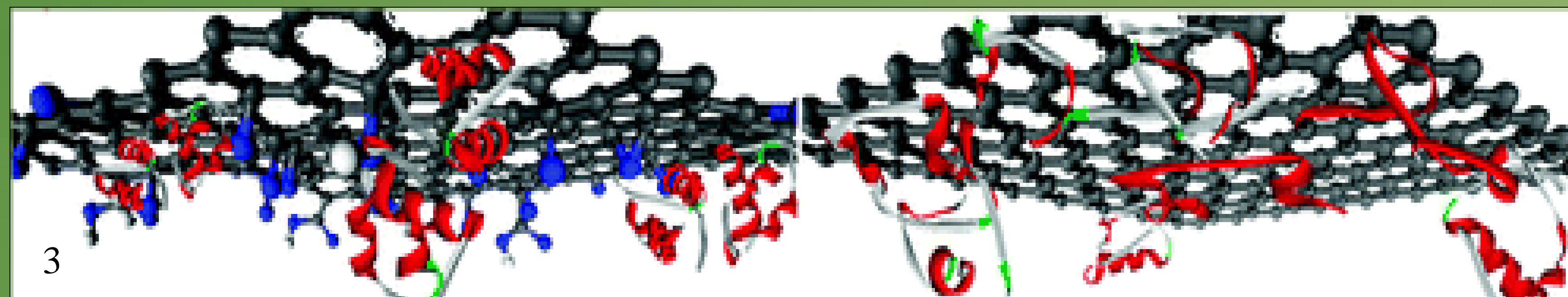
Research Question: Can viable cancer cells be grown on graphene sheets in a setting outside the body to effectively mimic common cancers acting within the body?

BACKGROUND

Graphene, discovered in 2004 by Konstantin Novoselov and Andrew Geim, is a transparent nanomaterial made of a single layer of carbon atoms in a hexagonal pattern. Its high conductivity makes it a useful addition to micro-transistors such as in cell phones.

Pure graphene is made of solely carbon atoms in a hexagonal double-bonded ring making it much stronger than its counterpart graphene oxide (GO). GO is a graphene sheet that is bonded with oxygen and oxygen groups. The extra atoms break the carbon-carbon double bonds making the sheets much less conductive and more prone to divergences of shape. Both graphene and graphene oxide sheets have been used to study cellular growth and differentiation with success.

Based on the properties of both, the broken bonds of GO allow for better adhesion to the sheet and substrate, but the solid bonds of graphene allow for more electrical conductivity and therefore more differentiation.



LITERATURE REVIEW

Graphene has recently been discovered to be useful in disassociating and differentiating Stem cells into neurons and glial cells (1). Its biocompatibility is advantageous to the medical and pharmaceutical industries. The process to create this differentiation included large-scale synthesis of graphene which was placed in a laminin solution to help the stem cells attach. This experiment was successful because the cells differentiated based on growth factors which were removed periodically over a long period of time.

Also successfully created, Mesenchymel stem cells from bone marrow were differentiated into three cell extractions (adipocytes, osteoblasts, and chondrocytes). In this experiment, Lee and company coated human bone marrow MSCs onto graphene and graphene oxide substrates. Several unusual patterns of differentiation were observed. Also observed and concluded, MSC adhesion occurred faster, which led to the hypothesis that interactions with other chemical inducers besides those used could in fact differentiate into other lineages as well (2). Also included is a detailed method of preparation and execution.

The use of graphene oxide films can be used in Retinal Pigment Epithelium which is also of neurological subject matter. The graphene oxide sheets allow for adhesion which in turn allows for the cells to grow (3). It is possible that large cell groups can be harvested via the same technique. In Liu and company's experiment, the biocompatibility of RPE cells with graphene sheets is examined. Details concerning the morphology, spectroscopy, amperometry, and reproducibility were collected and it was conceived that graphene oxide films could be utilized as biodevices.

METHODS

Since this experiment will be very similar to the process of growing stem cells on graphene and graphene oxide films, many of the methods I have left unchanged. Once the experiment is run, however, several things will be taken into account such as the number of cancer cells (if any do manage to grow), the time and growing conditions, and the statistical comparison to the control. To begin, a control experiment based on stem cell growth will be run with the specifications from Lee and company's paper and the description of neural stem cell growth by Agbenyega (1, 2). The control will be run with its own control based on the nutrients fed to various cell culture trials.

For my experiment, cell cultures from a cancerous area (possibly marrow, to better compare with the control) will be injected with an insulin solution onto the prepared graphene substrate. More research must be done before a decision can be made over a laminin preparation or a dip-coating preparation. Following the preset of cell growth procedures, the cells should adhere to the substrate and begin to differentiate and grow. To make the cells grow, the substrate will be bathed in a nutrient solution every eight hours instead of every three days as Lee and company prepared them. The increased feeding may or may not allow for a faster result. The experiment shall run for, and the cells be allowed to differentiate for, 14 days in a humidity-controlled environment at room temperature.

The results will be measured with a microscope, counter, and visible inspection. This experiment may have to be repeated numerous times to reach the 95 percent confidence level of the original procedure.

REFERENCES

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Photos courtesy of:

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