Measuring the Height to Angle Ratio of Dimpled-ground SiC Samples

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Problem

- Will height to ratio measure of a dated sample of SiC (silicon carbide) differ from its original measurements?
Background

• A detailed understanding of silicon carbide surfaces is of great importance for both fundamental SiC growth experiments as well as for technological applications.

• Growth of epitaxial graphene on SiC has been shown to begin at step edges.

• Control of the step-edge density and step bunching on the substrate is important for the production of large-area and high-quality graphene.
Research Objective

• The objective is to investigate the morphological and structural changes of a SiC sample that may have undergone oxidation.
Methodology

• Silicon Carbide samples were cleaned and prepared for etching.
• SiC sample was dimpled before etching
• Atomic Force Microscopy (AFM) was used to view the surface before processing.
• The samples were etched in the FirstNano Graphene Furnace in the Marcus clean room.
• AFM was repeated for morphological imaging
Results

- (a) Focuses on the rim of the depression. On the left, 1.5 nm high steps are observed with an average step distance of about 25nm.
- Moving over the edge further into the concave-shaped surface, the polar misorientation and consequently the step density increases as can be seen in (b).
- Further towards the center of the depression, regular and straight steps are observed (c)–(e).
- Near the center of the concave-shaped surface (d), the step density is extremely low and 0.75 nm steps are found.
Conclusion

• It is suggested that from the AFM imagery that there was not a significant change in the height to angle ratio of the dated SiC sample as compared to its original production date.
Using Graphene to Conduct Electricity

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Step-Up Fellowship

Lesson Plan
Standards

• Next Generation Science Standards
  – HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

• Georgia Performance Standards
  – SP5. Students will evaluate relationships between electrical and magnetic forces.
  – a. Describe the transformation of mechanical energy into electrical energy and the transmission of electrical energy.
  – b. Determine the relationship among potential difference, current, and resistance in a direct current circuit.
Resources

• Student Reference Sheet
• Student Worksheet
• Student Team Materials
  – Pencils
  – Paper
  – LED lights
  – 330 Ohm resistors
  – Insulated connectors
  – 9V batteries
Essential Questions

• What are the physical properties of graphene that makes it an ideal conductor or insulator?
• What are potential benefits of graphene and its impact of electrical technology?
Objectives

• Students will learn about nanotechnology and how engineers can harness the differences in how materials behave when small, to address challenges in many industries.

• Students will learn how to build and run an electrical circuit.

• Students will learn to measure current and voltage anywhere in the circuit.

• Students will determine the relationships between Current, Voltage and Resistance.
Sponge/Warm-Up

• Based on the reading material (*The Power of Graphene*) that was given during last class period, what are some potential applications for graphene?

• View video
  – [Graphene: The Next Wonder Material?](#)
Anticipatory Setting

• Hook (gain students’ interest)
  – The 9 Best Nanotechnology-Powered Products

• Direct Instruction
  – Lecture: Powerpoint Presentation
    Electrical circuits, insulators, and conductors
Work Period

• Students will work in teams to create a hypothesis.
• Decide whether graphene would be an electrical conductor or insulator.
• Write a paragraph to support hypothesis.
• Construct a simple circuit (test light bulb)
• Adjust circuit so that current flows through graphite layered paper.
Work Period

- Observation and Results
- Application Development
  - Based on the results of the experiment, students will prepare a brief presentation about how graphene might improve a product or allow the product to be smaller.
Closing

• Group presentations
• Reflection
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