UH professor taking next step with graphene research

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The 2010 Nobel Prize in Physics went to the two scientists who first isolated graphene, one-atom-thick crystals of graphite. Now, a researcher with the University of Houston Cullen College of Engineering is trying to develop a method to mass-produce this revolutionary material.

Graphene has several properties that make it different from literally everything else on Earth: it is the first two-dimensional material ever developed; the world's thinnest and strongest material; the best conductor of heat ever found; a far better conductor of electricity than copper; it is virtually transparent; and is so dense that no gas can pass through it. These properties make graphene a game changer for everything from energy storage devices to flat device displays.

Most importantly, perhaps, is graphene's potential as a replacement for silicon in computer chips. The properties of graphene would enable the historical growth in computing power to continue for decades to come.

To realize these benefits, though, a way to create plentiful, defect-free graphene must be developed. Qingkai Yu, an assistant research professor with the college's department of electrical and computer engineering and the university's Center for Advanced Materials, is developing methods to mass-produce such high-quality graphene.

Yu is using a technology known as chemical vapor deposition. During this process, he heats methane to around 1000 degrees Celsius, breaking

the gas down into its building blocks of carbon and hydrogen atoms. The carbon atoms then attach to a metallic surface to form graphene.

"This approach could produce cheap, high-quality graphene on a large scale," Yu said.

Yu first demonstrated the viability of chemical vapor deposition for graphene creation two years ago in a paper in the journal Applied Physics Letters. He has since continued working to perfect this method.

Yu's initial research would often result in several layers of graphene stacked together on a nickel surface. He subsequently discovered the effectiveness of copper for graphene creation. Copper has since been adopted by graphene researchers worldwide.

Yu's work is not finished. The single layers of graphene he is now able to create are formed out of multiple graphene crystals that join together as they grow. The places where these crystals combine, known as the grain boundaries, are defects that limit the usefulness of graphene, particularly as a replacement for silicon-based computer chips.

Yu is attempting to create large layers of graphene that form out of a single crystal.

"You can imagine how important this sort of graphene is," said Yu. "Semiconductors became a multibillion-dollar industry based on single-crystal silicon and graphene is called the post-silicon-era material. So single-crystal graphene is the Holy Grail for the next age of semiconductors."

Provided by University of Houston

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