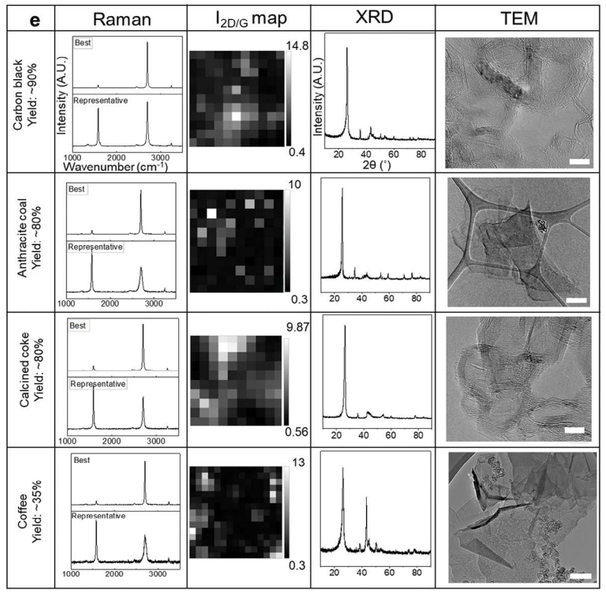
CONVERSION OF CARBON-BASED MATERIALS INTO EXCEEDINGLY HIGH-QUALITY GRAPHENE

Producing high-value solid products from domestic U.S. carbon ore.

ADVANCED CONVERSION PROCESS RAPIDLY PRODUCES LOW-COST, HIGH-QUALITY GRAPHENE

Researchers at Rice University have used an advanced conversion process called flash Joule heating (FJH) to rapidly produce low-cost, high-value graphene from coal using scalable next-generation technology and advanced manufacturing methods.

The FJH process is an energy-efficient method that can convert almost any carbon-based precursor into quantities of graphene in less than a second. The FJH process has a >90% processing yield with ~100% excellent quality graphene.

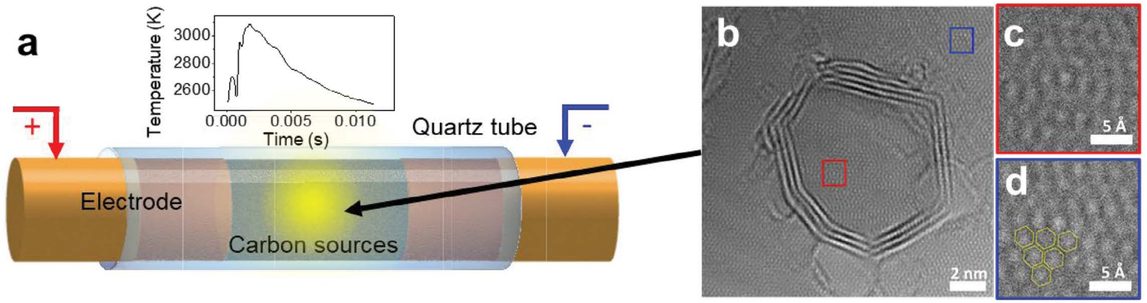


Carbon Sources to Graphene with Characterization Data (Scalebars 5,200, 5,100 nm Top to Bottom)

FJH IS AN ADVANCED MATERIALS SYNTHESIS TECHNIQUE

FJH is an innovative approach to graphene production that does not require chemicals, water, or purification steps. FJH uses a controlled amount of electricity, in this case referred to as a flash, to add thermal energy (measured in Joules) to the carbon material. The carbon is heated by this energy, which converts it into the desired form.

Electrical energy is stored in large capacitors and is discharged through the carbon-based material, which heats it to approximately 2,700 °C (4,892 °F). This controlled heating converts the carbon material into graphene flakes.

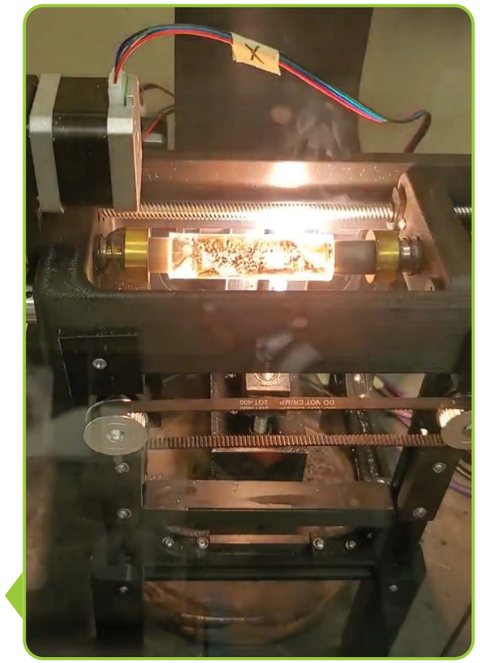


Carbon Materials are Converted Efficiently Into High-Quality Turbostratic Graphene

CARBON-BASED PRECURSORS CONVERTED TO GRAPHENE IN LESS THAN A SECOND

Using an automated FJH process, the Rice research team met the key project milestone of producing a total of 1 kilogram (kg) of graphene in less than one day (two hours).

The process is being further developed at a spin-off company, Universal Matter. Scaling of the process is aimed at achieving 1 ton per day graphene production in 2022 with the promise of much greater growth in the future.



Automation of FJH Graphene Process

GRAPHENE BENEFITS A WIDE VARIETY OF APPLICATIONS

Due to being composed of a single layer of carbon atoms tightly bound in a honeycomb-like pattern, graphene has incredible mechanical and electrical properties (e.g., tensile strength over 200 times greater than structural steel, and electrical conductivity greater than copper). Graphene shows promise in a wide variety of applications including composite building materials (such as cement, concrete, and plastics), automotive and aerospace parts, batteries and supercapacitors for energy storage, or as an electrical conductor.

PARTNERS

RICE UNIVERSITY

UNIVERSAL MATTER
ADVANCED MATERIALS

AWARD NUMBER
DE-FE0031794

PROJECT BUDGET

- DOE.....$750,000
- PERFORMER.....$187,500

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ADVANCE CRITICAL MINERALS, RARE EARTH ELEMENTS (REE), AND MINE REMEDIATION

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