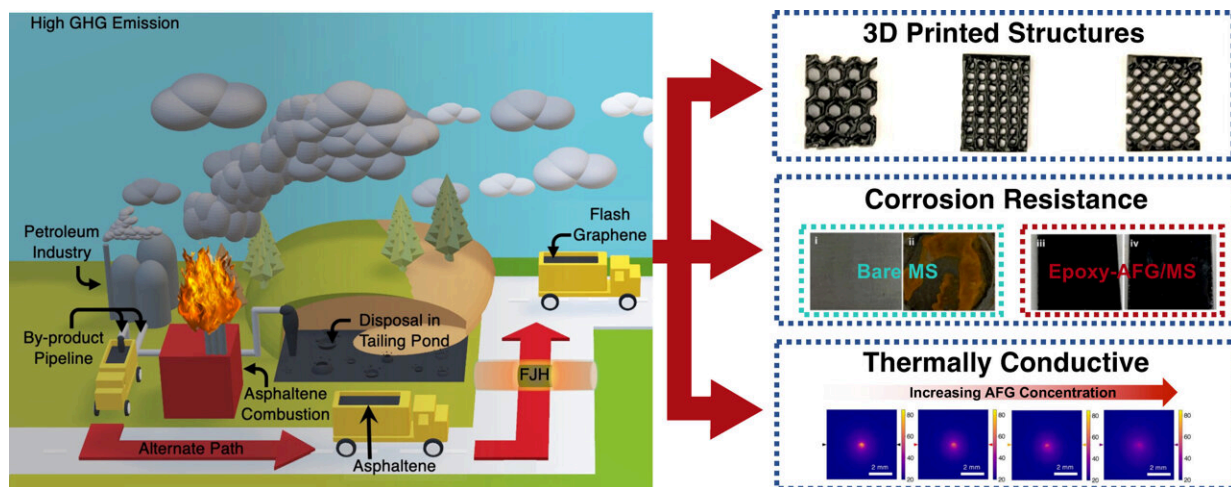


# Researchers turn asphaltene into graphene for composites

November 18 2022, by Mike Williams



Researchers at Rice University are pursuing the “sustainable valorization” of asphaltene by turning it into graphene useful for composite materials. Credit: M.A.S.R. Saadi/Rice University

Asphaltenes, a byproduct of crude oil production, are a waste material with potential. Rice University scientists are determined to find it by converting the carbon-rich resource into useful graphene.

Muhammad Rahman, an assistant research professor of materials science and nanoengineering, is employing Rice's unique [flash Joule heating](#) process to convert asphaltenes instantly into turbostratic (loosely aligned) graphene and mix it into composites for thermal, anti-corrosion and 3D-

printing applications.

The process makes good use of material otherwise burned for reuse as fuel or discarded into tailing ponds and landfills. Using at least some of the world's reserve of more than 1 trillion barrels of [asphaltene](#) as a feedstock for graphene would be good for the environment as well.

"Asphaltene is a big headache for the [oil industry](#), and I think there will be a lot of interest in this," said Rahman, who characterized the process as both a scalable and sustainable way to reduce [carbon emissions](#) from burning asphaltene.

Rahman is a lead corresponding author of the paper in *Science Advances* co-led by Rice chemist James Tour, whose lab developed flash Joule heating, materials scientist Pulickel Ajayan and Md Golam Kibria, an assistant professor of chemical and petroleum engineering at the University of Calgary, Canada.

Asphaltenes are 70% to 80% carbon already. The Rice lab combines it with about 20% of carbon black to add conductivity and flashes it with a jolt of electricity, turning it into graphene in less than a second. Other elements in the feedstock, including hydrogen, nitrogen, oxygen and sulfur, are vented away as gases.

"We try to keep the carbon black content as low as possible because we want to maximize the utilization of asphaltene," Rahman said.

"The government has been putting pressure on the petroleum industries to take care of this," said Rice graduate student and co-lead author M.A.S.R. Saadi. "There are billions of barrels of asphaltene available, so we began working on this project primarily to see if we could make carbon fiber. That led us to think maybe we should try making graphene with flash Joule heating."

Assured that Tour's process worked as well on asphaltene as it did on various other feedstocks, including [plastic](#), [electronic waste](#), [tires](#), [coal fly ash](#) and even car parts, the researchers set about making things with their graphene.

Saadi, who works with Rahman and Ajayan, mixed the graphene into composites, and then into polymer inks bound for 3D printers. "We've optimized the ink rheology to show that it is printable," he said, noting the inks have no more than 10% of [graphene](#) mixed in. Mechanical testing of printed objects is forthcoming, he said.

Rice graduate student Paul Advincula, a member of the Tour lab, is co-lead author of the paper.

**More information:** MASR Saadi et al, Sustainable Valorization of Asphaltenes via Flash Joule Heating, *Science Advances* (2022). [DOI: 10.1126/sciadv.add3555](#). [www.science.org/doi/10.1126/sciadv.add3555](http://www.science.org/doi/10.1126/sciadv.add3555)

Provided by Rice University

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