

ExxonMobil, Georgia Tech and Imperial College London Publish Joint Research on Potential Breakthrough in Membrane Technology

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- Research published in international peer-reviewed journal, Science

Scientists from ExxonMobil, the Georgia Institute of Technology and Imperial College of London have published joint research on potential breakthroughs in a new membrane technology that could reduce emissions and energy intensity associated with refining crude oil. Laboratory tests indicate the patent-pending membrane could be used to replace some heat-intensive distillation at refineries in the years ahead.

Results of the research were published today in the international peer-reviewed journal, Science.

"Through collaboration with strong academic institutions like Georgia Tech and Imperial, we are constantly working to develop the lower-emissions energy solutions of the future," said Vijay Swarup, vice president of research and development at ExxonMobil Research and Engineering Company.

"Inspired by reverse osmosis technology that has reduced energy intensity tenfold for water purification, we decided to look into ways to use new materials for liquids separation, which if brought to industrial scale, could significantly reduce associated greenhouse gas emissions," said Swarup. "This is one of many new materials ExxonMobil is researching to reduce energy intensity and CO₂ in our operations."

The research successfully demonstrated that naphtha and kerosene, the primary components of gasoline and jet fuel, can be separated from light crude oil using pressure instead of heat, reducing emissions and energy consumption significantly compared to traditional, heat-based distillation methods.

Since 2014, the team of scientists has worked to identify advanced membranes to separate light shale crude oil using significantly less energy than used in typical refining processes. In the gasoline and jet fuel range, the membranes developed by the team are twice as effective as the most selective commercial membranes in use today.

"This membrane technology was developed by a diverse team of scientists and engineers using a multi-scale approach that ranges from the molecular-scale to realistic membrane devices," said Ryan Lively, the John H. Woody faculty fellow and associate professor in Georgia Tech's School of Chemical & Biomolecular Engineering.

"It's rare that chemists have the chance to participate in both inventing new molecules and applying them to solve real-world problems. In this case, it really took a whole village of differing expertise to bring to fruition a new approach for separating the components of crude oil using much less energy than before," said M.G. Finn, Chair of the School of Chemistry & Biochemistry at Georgia Tech and a joint lead of the study along with Lively.

Additional research and development will be needed to progress this technology to industrial scale.

"We have the foundational experience of bringing organic solvent nanofiltration, a membrane technology becoming widely used in pharmaceuticals and chemicals industries, to market," said

Andrew Livingston, professor of chemical engineering at Imperial. "We worked extensively with ExxonMobil and Georgia Tech to demonstrate the potential scalability of this technology";

Since 2000, ExxonMobil has invested approximately \$10 billion in projects to research, develop and deploy lower-emission energy solutions. The company also continues to expand collaborative efforts with more than 80 universities, five energy centers and multiple private sector partners around the world to explore next-generation energy technologies.

The researchers on the technology as written in Science include Neel Rangnekar, J.R. Johnson, Scott Hoy and Benjamin McCool from ExxonMobil; Kirstie Thompson, Ronita Mathias, Ryan Lively and M.G. Finn from Georgia Institute of Technology; Daek Kim, Jihoon Kim, Irene Bechis, Andrew Tarzia and Kim Jelfs from Imperial College London; and Andrew Livingston, concurrently with Imperial and Queen Mary University of London.

About ExxonMobil

ExxonMobil (XOM), one of the largest publicly traded international energy companies, uses technology and innovation to help meet the world's growing energy needs. ExxonMobil holds an industry-leading inventory of resources, is one of the largest refiners and marketers of petroleum products, and its chemical company is one of the largest in the world. To learn more, visit exxonmobil.com and the Energy Factor.

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About Georgia Tech

The Georgia Institute of Technology, located in Atlanta, Georgia, is a leading research university committed to improving the human condition through advanced science and technology. As a leading technological university, Georgia Tech conducts interdisciplinary research that contributes vital research and innovation to government, industry, and business. Georgia Tech provides a focused, technologically based education to more than 36,000 undergraduate and graduate students. For more information, visit www.gatech.edu.

About Imperial College London

Imperial College London is one of the world's leading universities. The College's 17,000 students and 8,000 staff are expanding the frontiers of knowledge in science, medicine, engineering and business, and translating their discoveries into benefits for our society. Imperial is the UK's most international university, according to Times Higher Education, with academic ties to more than 150 countries. Reuters named the College as the UK's most innovative university because of its exceptional entrepreneurial culture and ties to industry. <http://www.imperial.ac.uk/>

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