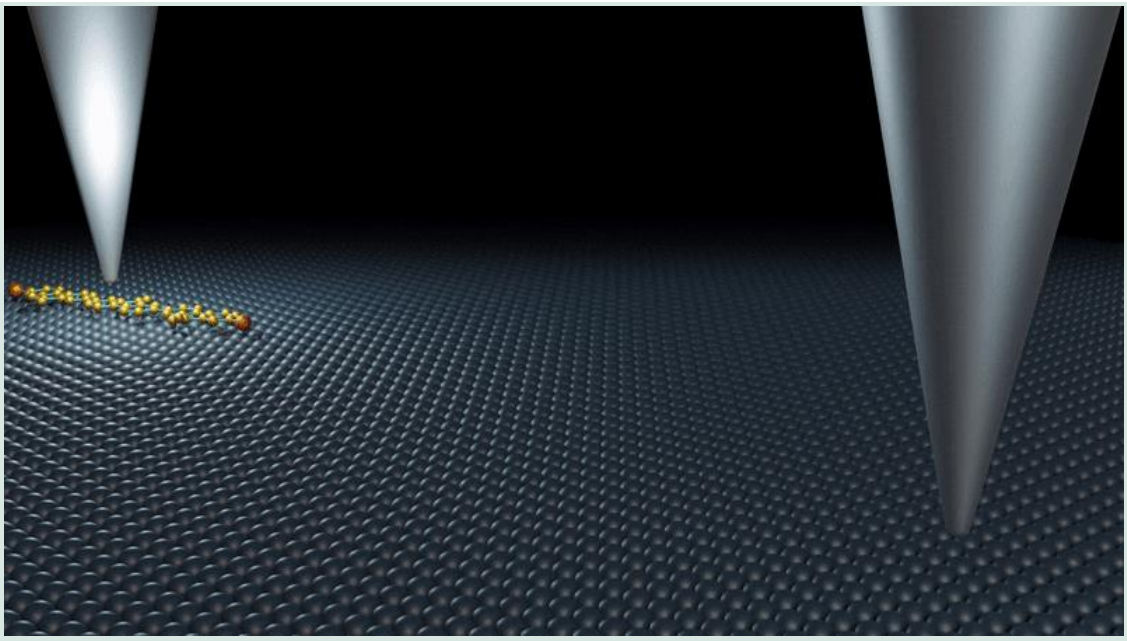
Microscopy – Nanoscale commuting



The animation depicts the controlled transport of a single molecule between two scanning tunneling microscope tips in an experiment at ORNL. Credit: Michelle Lehman/ORNL, U.S. Dept. of Energy

Oak Ridge National Laboratory's Center for Nanophase Materials Sciences, or CNMS, contributed to a groundbreaking experiment published in *Science* that tracks the real-time transport of individual molecules.

A team led by the University of Graz, Austria, used unique four-probe scanning tunneling microscopy, or STM, to move a single molecule between two independent probes and observe it disappear from one point and instantaneously reappear at the other.

The STM, made available via the CNMS user program, operates under an applied voltage, scanning material surfaces with a sharp probe that can move atoms and molecules by nudging them a few nanometers at a time. This instrument made it possible to send and receive dibromoterfluorene molecules 150 nanometers across a silver surface with unprecedented control.

"The project showcases precision instrument capabilities at the atomic level that open new frontiers in controllable molecules, or molecular machinery, for CNMS users," said ORNL's An-Ping Li.

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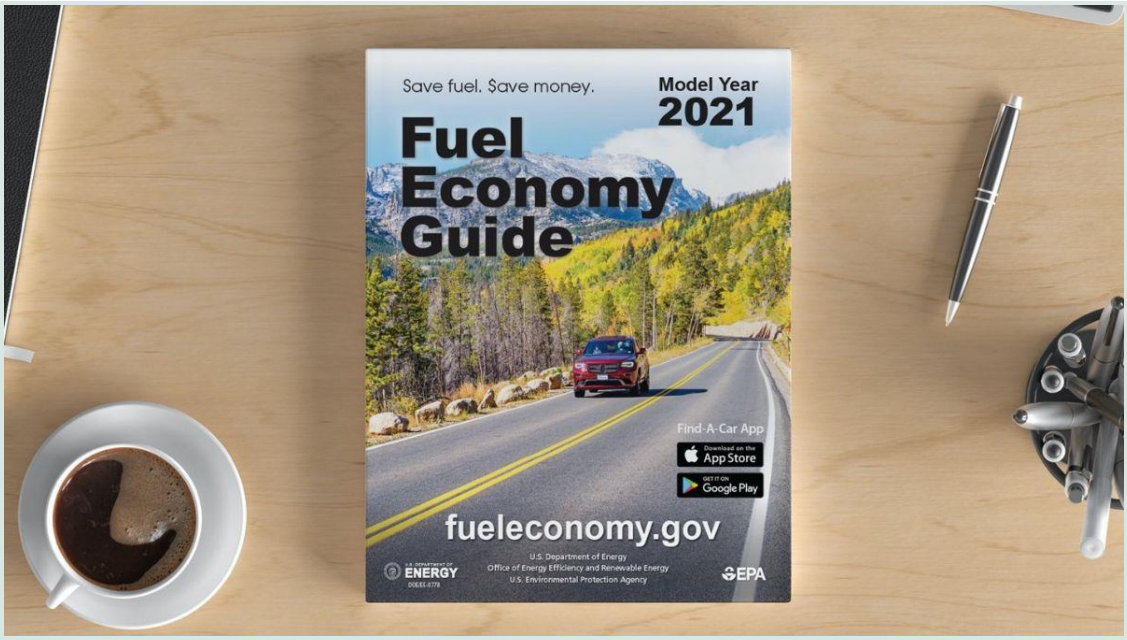
Transportation – Easy on the pedals



The 2021 Fuel Economy Guide, compiled by ORNL researchers, provides tips for keeping fuel costs down and helps consumers find the most fuel-efficient vehicle. Credit: ORNL/U.S. Dept. of Energy

Fuel economy can take a tumble when temperatures plummet, according to the Department of Energy's 2021 Fuel Economy Guide. Compiled by researchers at Oak Ridge National Laboratory, the guide includes several tips to improve a vehicle's fuel performance.

Parking your car in a warmer place, combining trips so that the vehicle is driven with a warm engine, and checking tire pressure regularly can all improve fuel economy. Driving sensibly, observing the speed limit and limiting idling can also save money year-round.

"Many people think idling to warm up a car will improve fuel economy in cold weather," ORNL's Stacy Davis said. "However, cars warm up faster when driven, and idling gets zero miles per gallon. So, idle your vehicle as little as possible."

The guide also helps consumers select the most fuel-efficient vehicle to save fuel and money in any weather.

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Manufacturing – Defect detection

A standard X-ray CT image of a 3D-printed metal turbine blade shows beam hardening and streaking effects. Credit: Amir Ziabari/ORNL, U.S. Dept. of Energy

Algorithms developed at Oak Ridge National Laboratory can greatly enhance X-ray computed tomography, or XCT, images of 3D-printed metal parts, resulting in more accurate, faster scans.

Industrial XCT is gaining popularity as a way to nondestructively inspect and qualify additively manufactured, or AM, parts. But the process is hampered by an effect called beam hardening that can affect the ability of standard algorithms to resolve small defects, such as pores and cracks, in reconstructed images.

To improve the process, ORNL researchers demonstrated a new method using a deep neural network trained on simulated data from computer-aided design models and physics-based information. The method reduces noise and artifacts and produces higher quality images significantly faster than typical algorithms.

“We aim to enhance the resolution and defect detectability in X-ray images which, in turn, will be instrumental for qualification and certification of AM parts,” said ORNL’s Amir Ziabari.

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