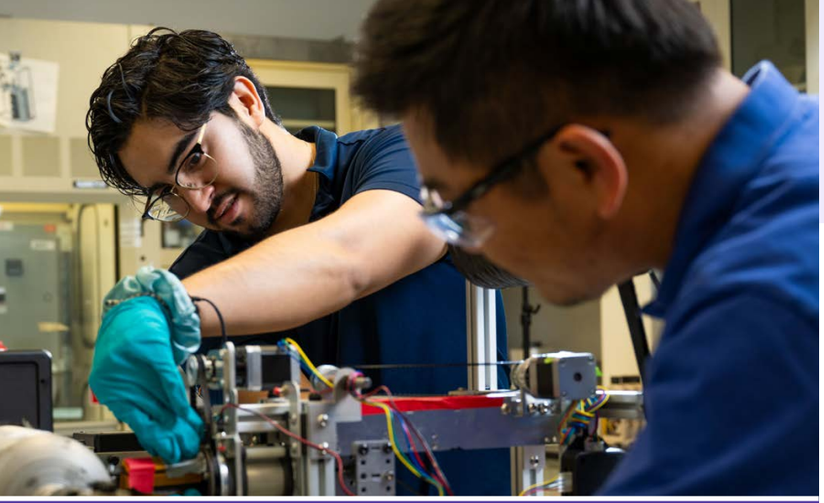

Researchers, including Yao Qiao, a materials scientist in the PNNL Applied Materials and Manufacturing Research group, and Cesar Moriel, a previous intern in the PNNL Applied Materials and Manufacturing Research group, established a filament winding protocol for fabricating subscale composite–overwrapped pressure vessels to advance the understanding of the process–property relationship and end-of-life recycling.

Researcher Areesa Trevino uses a HAAKE PolyLab OS modular torque rheometer for formulating and compounding elastomers with enhanced material performance for hydrogen applications.

Cover Image:
Researchers, including Areesa Trevino, a postmaster's research associate in the PNNL Applied Materials and Manufacturing Research group, conduct in-situ mechanical tests on natural gas pipeline materials to understand the effects of blending hydrogen into the U.S. natural gas infrastructure.

Advanced Instruments

- Microscopy and sample polishing
- Thermal analysis
- Gas chromatography–mass spectroscopy
- Mechanical testing (tensile, flexural, fatigue, and creep) with temperature and cryogenic control
- Environmental testing (salt spray, humidity, and thermocycling)

For More Information

To view all Polymer and Composite Materials Laboratory instruments and capabilities, scan the QR code or visit:
pnnl.gov/pcmlab

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Polymer and Composite Materials Laboratory

Fabrication, Testing, and Characterization

Pacific Northwest National Laboratory scientists and engineers develop innovative, energy-efficient materials and processes to enhance durability, performance, and environmental compatibility for next-generation technologies.

Developing Innovative, Energy-efficient Materials and Processes

- Recycling or upcycling of carbon fiber–reinforced composites and plastics
- Environmental degradation of materials
- Life cycle and hydrogen permeation analysis
- Hydrogen compatibility and environmental durability testing, including cryogenic testing in liquid H_2 conditions.
- Studies on energy absorption and impact resistance of plastics and composites
- Experimental and computational modeling of the damage, fracture, and nonlinear behavior of polymers and reinforced composites

Enhancing Durability, Performance, and Environmental Compatibility

- Low-cost and specialized composite manufacturing methods (e.g., pultrusion)
- Prototype-scale composite fabrication
- Rubber formulation and compounding
- Adhesive joining of multi-materials
- Polymer synthesis, formulation, and surface chemistry modification
- Hybrid structural composites and natural fibers (bio-based and geo-based)

Dounia Boushab, a postdoctoral research assistant in the PNNL Applied Materials and Manufacturing Research group, uses injection molding to up-cycle industrial waste into high-value construction materials.

A polymer sample in tensile creep, part of a pressure vessel designed to test integrity and strength of materials exposed to hydrogen.

Full Spectrum of Capabilities and Equipment

Testing and Material Characterization

- In-situ observatory with digital image correction
- In-situ tribometer
- In-situ bending and creep testing
- Impact tester
- Rheometer
- Nanoindentation
- Hydrogen permeation testing
- Cryogenic testing at 4 kelvin

Manufacturing Techniques

- Injection molding
- Hot pressing
- Compression transfer molding
- Vacuum forming
- Filament winding
- Resin transfer molding
- Autoclave
- 3-D printing
- Ultrasonic welding
- Laser cutting
- Water jet cutting

Material Processing and Compounding

- Ball milling
- Filabot extruding
- Melt flow indexing
- Powder dispensing
- HAAKE compounding and mixing

Surface Treatment and Coating

- Plasma surface treating
- Loctite adhesive dispensing robot
- Spin coating
- Surface conditioning processes