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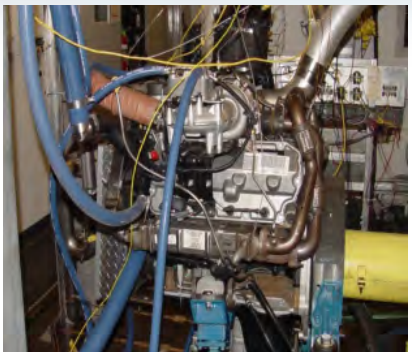
Propulsion Materials Program

Oak Ridge National Laboratory's (ORNL) Propulsion Materials Program partners with the U.S. Department of Energy's (DOE) Office of Vehicle Technologies ***to identify and develop advanced materials and processes that improve powertrain system efficiency and reduce emissions.*** Cutting-edge materials research is crucial to enabling new vehicle technologies that are reliable, fuel efficient, and clean. ORNL researchers, in close collaboration with U.S. industry, are focusing on materials for ***advanced engines, hybrid and electric drive systems, and vehicle exhaust systems.*** These materials promote a variety of performance benefits, including ***lightweighting, higher temperature capabilities, emissions reduction, thermal management, and corrosion mitigation.*** The program utilizes ORNL's unique suite of materials processing, characterization, and testing capabilities, including its neutron science, high resolution microscopy, mechanical properties, and engine testing facilities. Furthermore, advanced materials modeling methods are being utilized to more effectively design and improve critical materials for specific applications. The result is more rapid delivery of a wide range of advanced technologies that enable U.S. manufacturing of higher efficiency drivetrains.

ORNL Propulsion Materials also supports the following DOE Vehicle Technology Programs:

- Power Electronics & Electric Motors
- Lightweight Materials
- Non-Petroleum Fuels
- Combustion & Emission Controls
- Solid State Energy Conversion



Recent Highlights

- New stainless steel alloys (CF8C-Plus) with improved creep resistance enable use of lower cost materials for advanced turbocharger housings and exhaust regeneration systems.
- New, lower-cost (reduced Ni) exhaust valve alloys are being developed for high efficiency engines.
- First principles calculations led to the development of a new low temperature catalyst material (CuFe-SSZ-13), with demonstrated stable properties from 150°C to 600°C.
- Effects of alternative fuel use on the elevated temperature corrosion of lightweight engine alloys are being systematically explored, with new mechanisms recently identified.
- Novel microscopy methods for high resolution imaging of active catalysts under actual temperature and environment have been developed to understand (and control) catalyst reactions at an atomic level.
- Advanced thermoelectric materials with optimized dopant levels were identified via first principles computations, with subsequent manufacturing and measurement of p-type PbSe resulting in a ZT of approximately 1.7 (one of the highest to date).
- Integrated modeling and mechanical properties measurements on diesel particulate filters (DPFs) revealed an order-of-magnitude lower elastic modulus for cordierite DPFs compared to literature values; this means that actual service stresses are far lower than previously thought, thereby enabling increased design flexibility with no loss in DPF durability.

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