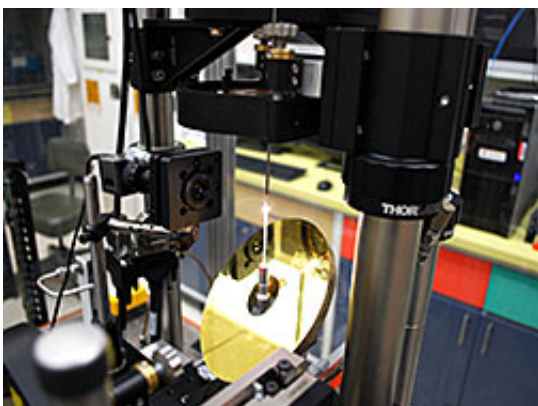


New capability takes sensor fabrication to a new level

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A sapphire rod being melted in the Laser Heated Pedestal Growth system. A sapphire seed crystal is being lowered onto the molten sapphire rod to begin the growth of a single-crystal sapphire fiber.

Operators must continually monitor conditions in power plants to assure they are operating safely and efficiently. Researchers on the Sensors and Controls Team at DOE's National Energy Technology Laboratory can now fabricate prototype optical sensors that demonstrate superior properties in comparison to traditional sensors using a new laser-heated pedestal growth (LHPG) system. According to NETL researcher Michael Buric, "The new sensors have broader functional temperature ranges, increased durability, and reduced cost. Sensors produced using LHPG will be capable of operating in the high temperature and harsh environments associated with advanced power systems."

LHPG is a [crystal growth](#) technique that reforms bulk high temperature-resistant materials, such as sapphire or YSZ (yttrium stabilized zirconium), into single-crystal optical fibers. The technique produces optical fibers with very high melting temperatures for use as sensor substrates. The LHPG system enables researchers to precisely control crystal growth, and to incorporate novel sensor materials with fiber-substrates during the growth process. The ability to control fabrication parameters along with high temperature-resistant materials generates [optical fiber sensors](#) with improved measurement sensitivity and durability. The optical fibers developed at the new facility will be incorporated into fiber sensor assemblies and evaluated for functionality under high temperature and pressure conditions. The materials that demonstrate the most promising performance characteristics will be further evaluated in various sensing configurations.

Optical fiber-based sensors offer distinct advantages including broadband wavelength and compatibility, and resistance to electromagnetic interference. They also eliminate electrical wires and contacts, which are commonly associated with sensor failure. Additionally, fiber optic sensors are compatible with embedded, remote, and distributed sensing technologies.

Innovative process control systems capable of functioning in the extreme environments of conventional and future fossil fuel-based power generation systems will play a key role in improving efficiency while reducing carbon dioxide (CO₂) emissions.

Advanced sensor materials will enable continued use of our coal resources to improve U.S. economic competitiveness while providing global environmental benefits through reduced greenhouse gas emissions. The sensors developed using LHPG could also be applied to process monitoring and control for other energy systems, including solid oxide fuel cells, gas turbines, boilers, and oxy-fuel combustion. [Other](#)

[research](#) at NETL is expanding the application of fiber optic-based sensors for use in subsurface monitoring including unconventional, deep, and ultra-deepwater oil and gas resource recovery and CO₂ storage.

Provided by US Department of Energy

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