Cost-Effective Smart Materials for Diesel Engine Applications

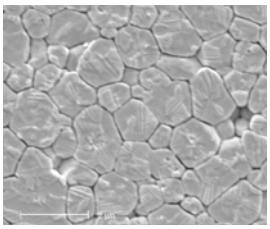
Background

A major driver in diesel engine research is to increase fuel efficiency and to lower the pollution to the environment. Multiple fuel injections per combustion cycle can increase the fuel efficiency and lower the NO_x and particulate emissions from diesel engines. Due to the present stroke speed limitations of magnetic solenoid valves, multiple injections require the development of high-speed actuators. The leading candidate devices for these actuators are lead zirconium titanate (PZT) due to lower materials costs and performance. PZT materials are widely used for actuators and sensors in applications requiring precision control and high force with small sizes. Multilayered PZT materials have been studied and are favored for their low power consumption and high precision control. Widening the application of PZT transducers will require improvements in properties of the PZT materials and at the same time reduce the materials costs.

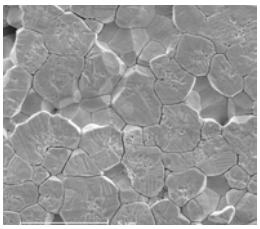
What Can Be Done?

The present work is directed toward developing a low cost actuator to be used in fuel injectors in diesel engines. Such a multi-layer PZT actuator must sinter to full density below the melting point of silver (960 ^{o}C) so that costly Pd alloys will not be needed as the interlayer electrodes.

Commercial PZT material



ORNL Low-Temp. PZT



Recent Progress

- Evaluated behavior of commercial piezoelectric (PZT) and magnetostrictive (Terfenol-D) -based actuators.
- Developed and characterized low-temperature PZT materials that sinter below 960 °C and compared to commercial materials that sinter >1250 °C

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