

A Fiber Optic Sensing Cable for Monitoring Enhanced Geothermal Systems

A suite of optical sensors for monitoring pressure and temperature in enhanced geothermal systems (EGS) that is also applicable to oil and gas wells, is being developed by a team of researchers from AFL, General Electric Co., QOREX, and Sandia National Labs. In the second year of this government sponsored project, a fiber optic cable and key sensing subsystems have been designed, fabricated and tested in the laboratory for temperature and pressure response and accuracy, reliability and survivability at temperatures up to 400°C and for hydrogen darkening of the fiber at high temperature and pressure.

Four different sensors for point pressure measurements have been designed and fabricated for operation in EGS environments with an optical fiber connection. A comprehensive survey of the specialty fiber supply chain led to procurement of a set of high temperature, hydrogen-tolerant fiber candidates that were evaluated for mechanical and hydrogen performance. Both multimode and single-mode fibers have been qualified with polyimide and metal coatings. An FBG sensor for distributed pressure sensing has been designed for temperatures up to 400°C. The accuracy of a Raman distributed temperature sensing instrument has been demonstrated for use with pure silica core fiber even when the fiber exhibits differential fiber attenuation from a nominal amount of reversible hydrogen darkening. Results of the open and closed loop pressure sensing measurements, temperature dependence, manufacturing tolerance and initial downhole field tests are described in a paper presented at the Thirty-Seventh Workshop on Geothermal Reservoir Engineering at Stanford University, Stanford, California, Jan. 30 - Feb. 1, 2012.

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