Magnet-assisted Fiber Optic Sensing for Internal and External Corrosion-induced Mass Losses of Metal Pipelines under Operation Conditions

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Main Objective

This project was awarded to Missouri S&T in order to develop and demonstrate an integrated system of multiple FBG/EFPI and multiplexed LPFG sensors for internal and external pipeline corrosion monitoring at critical sections under operation conditions.

\[ I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos\left(\frac{4\pi n_1 L}{\lambda} + \varphi_0\right) \]

\[ \lambda_{\text{res}} = (n_{\text{eff}} - n_{\text{eff,0}}) \Lambda \]

Figure 1. Principle and fringe pattern of EFPI.

Figure 2. Resonance wavelength equation and coupling effect of the LPFG

Project Approach

(1) Design a high sensitivity, magnet-assisted, hybrid sensor of Fiber Bragg Gratings (FBG) and extrinsic Fabry-Perot interferometer (EFPI) for simultaneous measurement of temperature and pipe wall thickness.

(2) Develop graphene-based Fe-C coated sensor with long period fiber gratings (LPFG) for accurate measurement of pipe wall thickness due to external corrosion.

Results

(1) The proposed sensors can measure the corrosion induced mass loss of the pipeline accurately in both external and internal setup.

(2) The combined EFPI/FBG can simultaneously measure the corrosion induced mass loss and temperature.

(3) The graphene-based Fe-C coated LPFG sensor is very sensitive to the corrosion-induced mass loss of the Fe-C layer.

Figure 3. Schematic view of the hybrid EFPI/FBG sensor set up.

Figure 4. Optical spectra and EIS data acquisition of the Fe-C coated LPFG sensor.

Figure 5. Cavity length change of the EFPI vs. steel plate thickness.

Figure 6. Resonance wavelength shift of the LPFG vs. corrosion-induced mass loss of the Fe-C layer.

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References


Public Project Page

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