Composite Self-sensing Thermal Sprayed Coatings for Pipeline Corrosion Prevention and Mitigation

F. Azarmi[1], Y. Huang[2], S. Abuali Galedari[1], and Xiao Liang[2]
Department of Mechanical Engineering [1]
Department of Civil and Environmental Engineering[2]
North Dakota State University, Fargo, ND 58108-6050

✓ Main Objective

This project was awarded to "Fardad Azarmi & Ying Huang" in order to develop and evaluate an innovative composite self-sensing thermal sprayed coatings to prevent, inhibit or mitigate, and manage pipeline corrosion for on-shore buried metallic transmission pipelines.

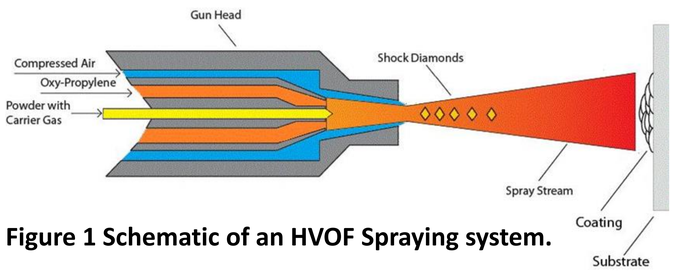

Figure 1 Schematic of an HVOF Spraying system.

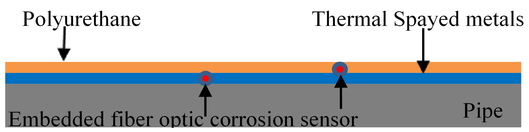

Figure 2 Schematic of the composite self-sensing thermal sprayed coating.

✓ Project Approach/Scope

Corrosion, a leading cause of failure in metallic transmission pipelines, significantly impacts the reliability and safety of metallic pipelines. A reliable, cost-effective, and environmental friendly pipeline corrosion mitigation approaches are yet achieved. this proposal focuses on the following main tasks:

- ❖ ***Materials selection***
- ❖ ***Develop an optimized applicable thermal sprayed coating for corrosion mitigation***
  - ➢ ***Materials selection***
  - ➢ ***Optimization of Spraying parameters***
- ❖ ***Development of Embedded Sensing System in Coatings.***
  - ➢ ***Evaluation of sensor-coating set-up***
  - ➢ ***Optimization of the sensing system***
- ❖ ***Performance Evaluation of the Developed Innovative Coatings***

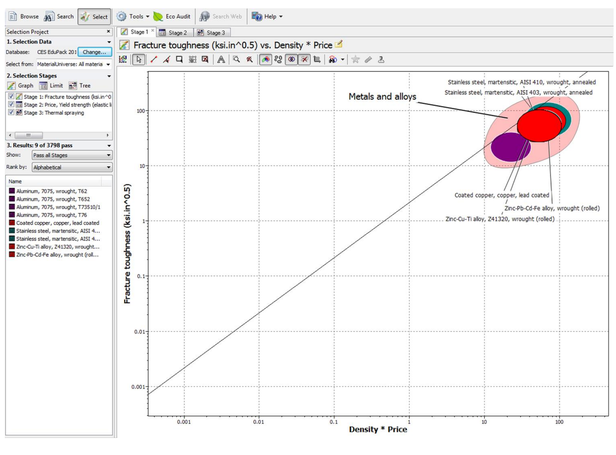

Figure 3 Materials selection chart.

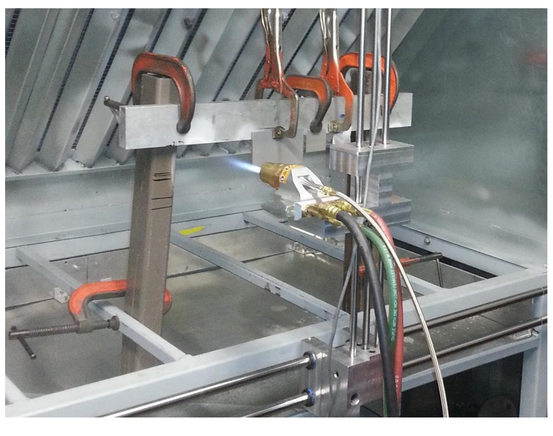

Figure 4 HVOF Spraying process.

✓ Self-Sensing Composite Coatings and Results to Date

Coating samples with embedded Fiber Bragg grating (FBG) sensors have been prepared and evaluated for the proof of concept. Different temporary set-up and masking system was designed to protect and fix the FBG sensors during spraying process. Materials selection method indicated that *stainless steel*, *copper* and *zinc* alloys are the optimum materials for corrosion protection.

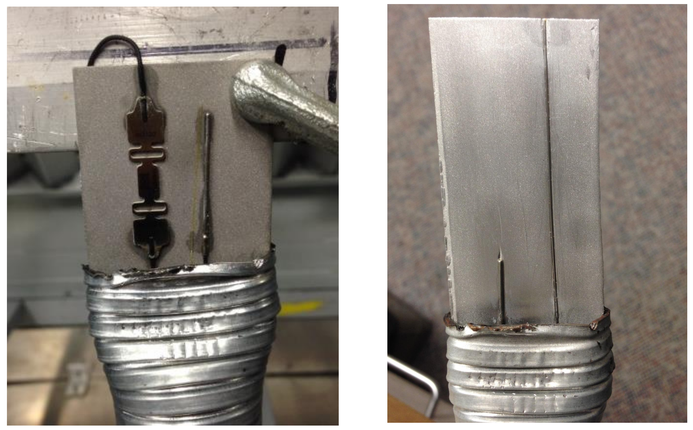

Figure 5 Two different temporary sensor set-up for spraying.

The wavelength were obtained from strain and temperature sensors.

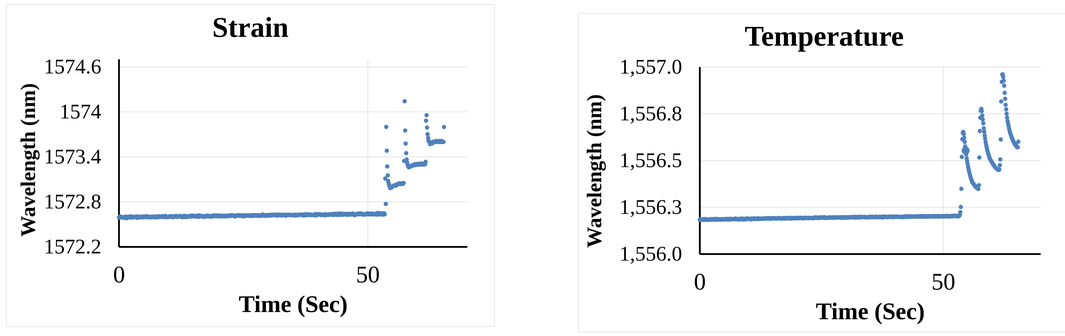

Figure 6 Collected wavelengths during the spraying (left) strain and (right) temperature.

The embedment of the fiber optic sensors to withstand harsh spraying condition and corrosion resistant properties of the final coating needs to be addressed in this study.

✓ Acknowledgment

This project is funded by DOT/PHMSA's through Agreement No. DTPH56-13-H-CAAP05.

Public Project Page

Please visit the below URL for much more information:

http://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=509