Mitigating Pipeline Corrosion Using A Smart Thermal Spraying Coating System

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➢ Background and Objectives

Corrosion is known as one of the major structural defects for steel structures such as pipelines. Therefore corrosion prevention and mitigation has been long recognized as a critical task for pipeline industry. Although various of coating and assessment methods have been utilized; reliable, cost-effective, and environmental friendly corrosion mitigation approaches are yet achieved. In the main goal of this project, developing and enhancing an innovative smart thermal sprayed coating for on-shore buried metallic transmission pipelines was set as the priority.

➢ Material Selection and Thermal Spraying Method Selection

Selection for material and thermal spraying method was done by literature review. In addition, a systematic material study was also carried out by software CES based on various of material properties such as corrosion resistance, density and cost. Applied coatings were further investigated by SEM and optical microscopes to assure the quality. Figure 1 shows an example of material selection through CES. Stainless steel alloys, copper based, and zinc based alloys have been selected as coating materials. Figure 2 shows one the coating sample and the coating process with an automatic robotic arm. Figure 3 shows the microscope study of applied coatings.

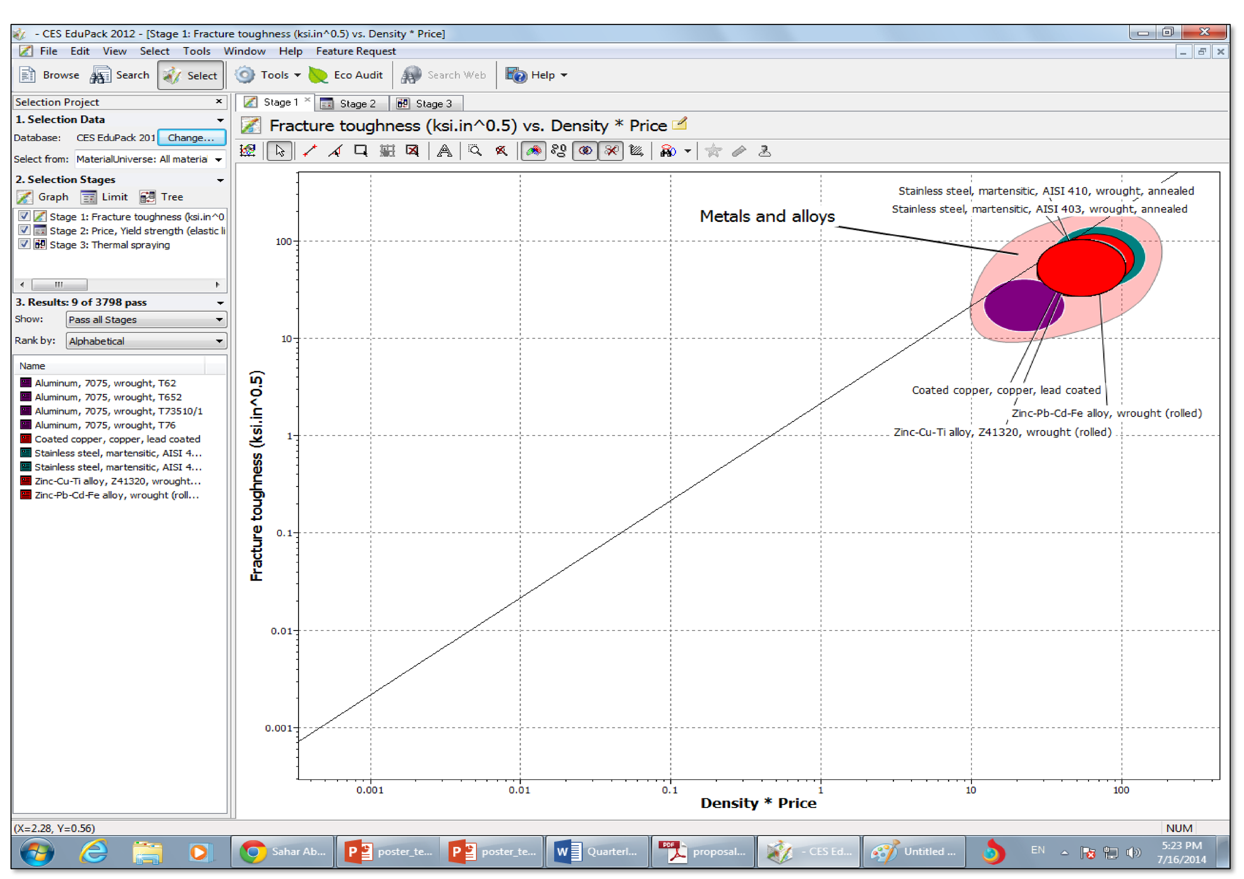


Figure 1 Material selection with CES software

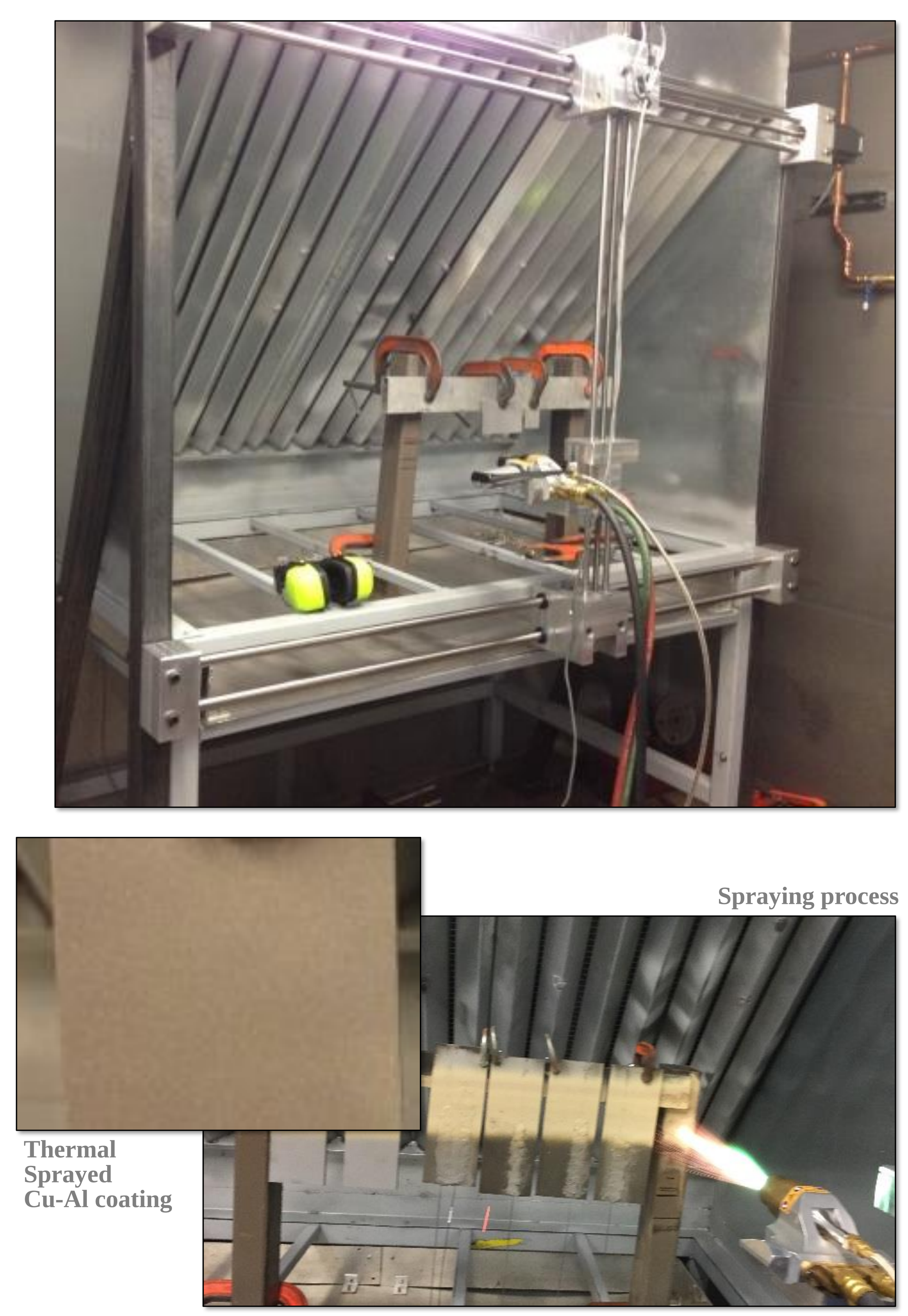
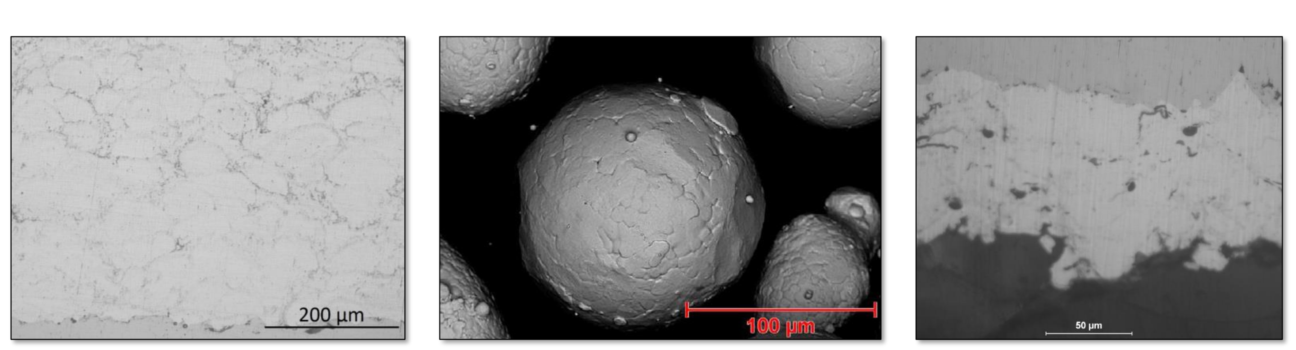


Figure 2 Automatic robotic arms coating samples



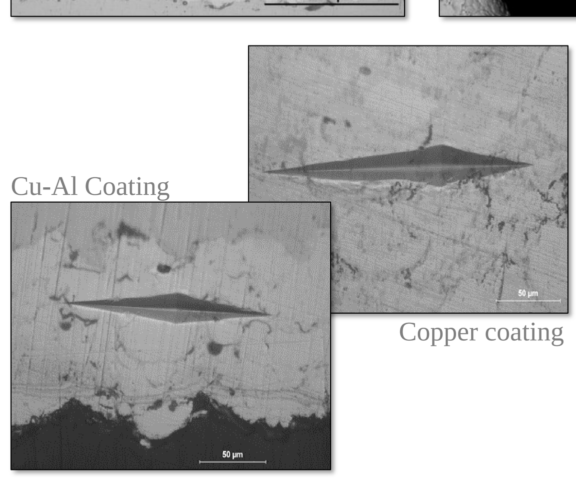


Figure 3 Coating properties identification

➢ Acknowledgment

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➢ Self-Sensing Composite Thermal Spraying Coating

Fiber Bragg grating (FBG) sensors were selected to be embedded inside the coating providing data which can be used for corrosion assessment (advantages of FBGs: non-sensitivity to chemical environments, immunity to EMI and moisture, capability of quasi-distributed sensing, and long serving life). Coating samples had been prepared to test the concept of embedded corrosion monitoring system (shown in Figure 4 and 5).

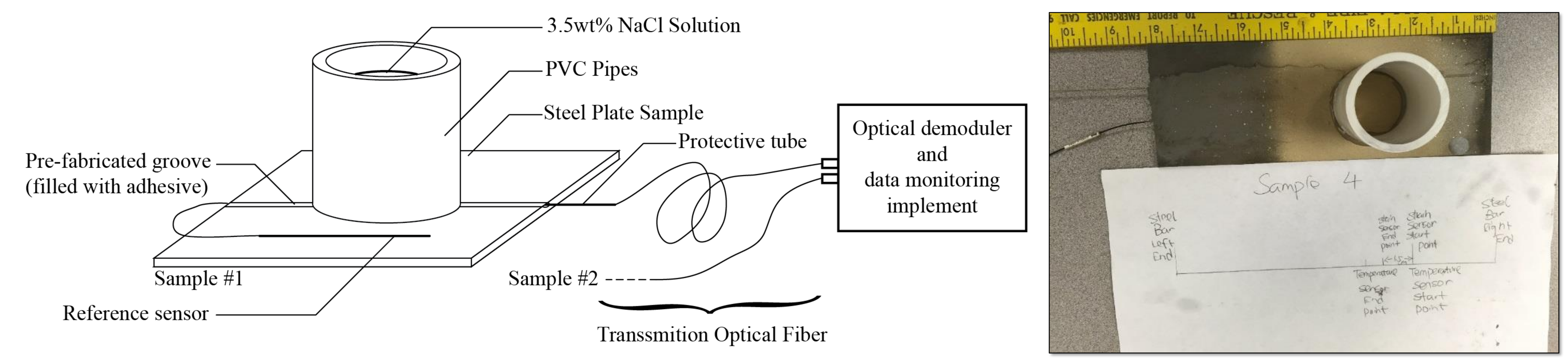

Figure 4 Test environment for coated sample with FBG sensors embedded

Data collected from samples had shown that the proposed corrosion monitoring system is capable of recognizing both the initiation and the development of corrosion, and at the same time has potential of monitoring the corrosion rate. Additionally, different corrosion patterns (pitting and uniform) are distinguishable by referring to the data curve type.

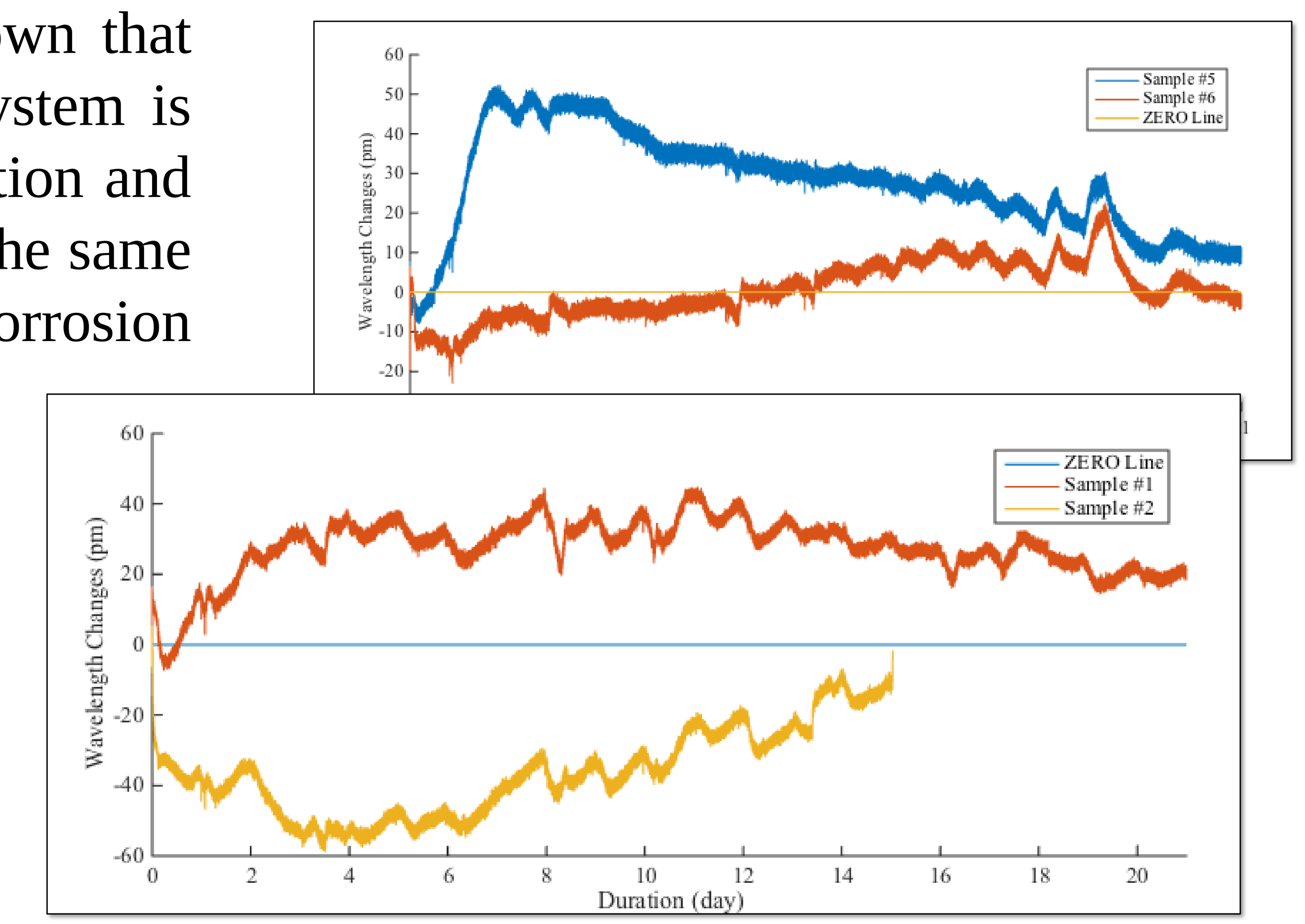

Figure 5 The variation of changes in the center wavelength of the embedded sensing system

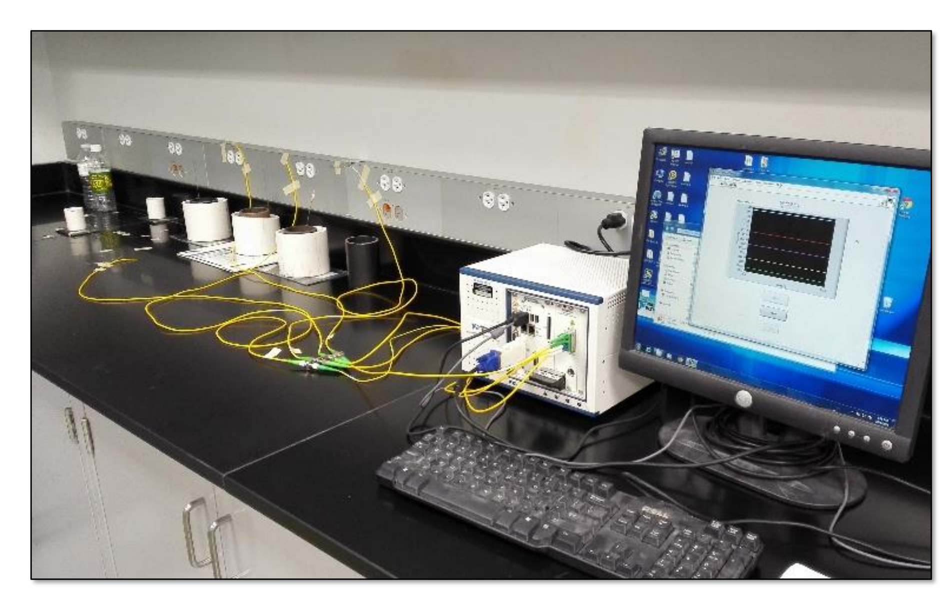

Figure 6 Test and date collecting system set-up of accelerated corrosion test for coated samples

✓ Conclusions and Future Work

In this project, a smart thermal spraying metallic coating was developed for pipeline corrosion prevention and mitigation. The integrated sensing system enables the thermal sprayed metallic coating to be self-sensing when the coating is performing for corrosion prevention, and the effectiveness of the proposed system has been proven by conducted experiments. Future studies will be performed on the further improvement the corrosion mitigation of the coating using various sealing techniques and the further investigation of using the sensing system to quantitatively assess the corrosion.