

# Corrosion Monitoring and Testing of Concrete and Steel Structures

**KEYWORDS**

Reinforced Concrete and Steel Structures

Corrosion of Reinforcing Steel

Modeling

Sensor Corrosion Monitoring and Diagnostics

Diamond-Like Carbon Coating

Coating Degradation

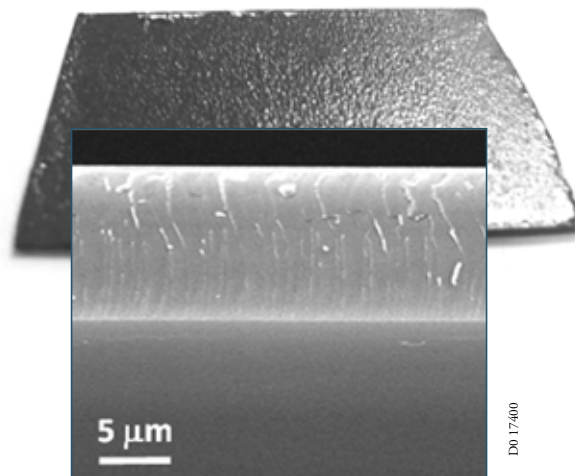
Corrosion Modeling

Wireless Corrosion Monitoring and Diagnostics

**S**outhwest Research Institute® (SwRI®) is an internationally recognized center for material development and characterization as well as corrosion monitoring of concrete and steel components. SwRI is engaged in the development of novel coatings for steel reinforcements, corrosion modeling in concrete structures, and wireless corrosion monitoring. Engineers at SwRI have conducted a wide range of tests to assess concrete and steel degradation.

## Coating Development for Reinforced Concrete and Steel Structures

SwRI engineers have developed a cost-effective, environmentally friendly synthetic diamond-like carbon (s-DLC) coating that can be deposited onto steel from a plating bath at low temperatures and normal atmospheric pressures. This novel coating has shown corrosion resistance and mechanical testing performance expected to surpass that of commercially available epoxy coatings.



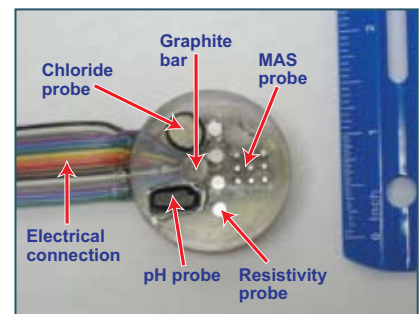
s-DLC film on glass slide

## Corrosion Monitoring

SwRI engineers have developed an integrated concrete transducer prototype for monitoring the probability of corrosion in concrete structures. The transducer is capable of measuring chloride ion concentration, pH, localized and uniform corrosion rates, and resistivity. The miniature size simplifies its installation into new or existing structures.



Coating degradation sensor



Concrete transducer prototype

SwRI engineers have developed a multi-sensor system for *in-situ*, real-time monitoring of protective coating degradation and incipient substrate metal corrosion on steel bridges. The sensor provides bridge maintenance engineers with automatic warnings of the onset of incipient coatings/steel problem conditions prior to visible indications. This facilitates proactive maintenance decisions resulting in low-cost repair/rehabilitation actions.

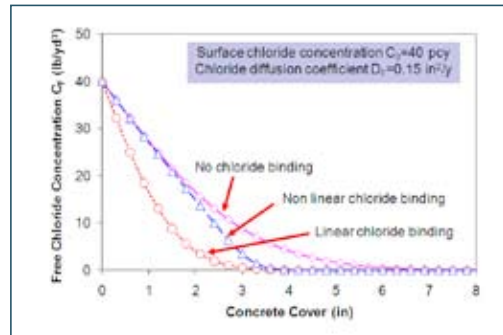
The transducer is integrated with a low-power electronics package capable of wireless data transfer using Wi-Fi protocols through a gateway unit with connectivity to a cell phone network.



Wireless sensor network architecture

## Testing and Corrosion Modeling of Concrete and Steel Components

For the past decade, SwRI has used field and laboratory data to validate numerical models for the purpose of forecasting the remaining service life of engineering structures. Combining these models with wireless sensors provides the capability to determine field maintenance intervals.



Chloride profile as a function of concrete cover depth



Evaluation of cathodic protection and usable lifetime of anodes under controlled soil resistivity for concrete applications



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We welcome  
your inquiries.

For additional  
information,  
please contact:

Leonardo Caseres, Ph.D.  
Research Engineer  
(210) 522-5538 • Fax (210) 522-5122  
leonardo.caseres@swri.org

Hui Yu, Ph.D.  
Research Engineer  
(210) 522-5728 • Fax (210) 522-5122  
hui.yu@swri.org

Materials Engineering Department  
Mechanical Engineering Division  
Southwest Research Institute  
6220 Culebra Road (78238-5166)  
P.O. Drawer 28510 (78228-0510)  
San Antonio, Texas



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