PREP Research Associate

This position is part of the National Institute of Standards (NIST) Professional Research Experience (PREP) program. NIST established the PREP program, comprising multiple academic institutions, to facilitate its research staff collaborating with researchers at academic institutions on specific projects of mutual interest. The PREP program engages staff from a wide range of backgrounds in scientific research across many areas, enabling technical work that underpins the metrology needs of a broad range of industries.

Research Title: Metrology for Steel Corrosion in Innovative Cement Materials

The Infrastructure Materials Group (IMG) at NIST serves as an important resource for developing science-based tools and measurement standards to enhance the resilience and sustainability of the nation's physical infrastructure. The degradation of reinforced concrete as a direct result of embedded steel corrosion remains a monumental challenge, with direct and indirect costs consuming approximately 6 % of the U.S. Gross Domestic Product.

Current building codes, testing standards, and common-practice heuristics, such as diffusion coefficient, depth of cover, and chloride per unit mass of cement, are inadequate for assessing the complex environmental factors and novel binder chemistries that most strongly affect structural service life. To address this, the IMG "Assessing Steel Corrosion Risk in Innovative Cement Concretes" project aims to combine advanced electrochemical characterization with species transport modeling. We are seeking a highly motivated Postdoctoral Researcher with academic training and experience in corrosion science to develop new metrology standards specific to reinforced concrete structures, which are often in unsaturated conditions. The selected candidate will focus on measuring the precise rates of corrosion initiation and progression, ultimately providing the foundational data needed to build high-fidelity service-life and fragility models for reinforced concrete structures.

Key responsibilities will include, but are not limited to:

The successful candidate will be tasked with designing fundamental laboratory studies, developing novel metrology, and advancing predictive models. Core duties include:

Electrochemical Metrology & Testing: Design and conduct advanced bench-top electrochemical assessments of reinforcement steel to measure corrosion initiation and progression rates under varied solution properties and environmental conditions.

Advanced Data Collection: Utilize Electrochemical Impedance Spectroscopy (EIS), potentiodynamic polarization, open-circuit potential (OCP), and linear polarization resistance (LPR) to accurately quantify corrosion current density, corrosion potential, and charge transfer resistance. Also, develop measurement plans to obtain Point Defect Model (PDM) parameters for modeling rebar passivation and passive film breakdown.

Microstructural Characterization: Perform high-resolution materials characterization utilizing Scanning Electron Microscopy- Energy Dispersive X-Ray Spectroscopy (SEM-EDS) to study the steel-concrete interface and understand the morphology of localized degradation.

Model Integration: Translate fundamental bench-top corrosion data and transport property measurements into accurate inputs for numerical and structural models, connecting atomic-level physicochemical mechanisms to building-scale performance.

Qualifications

Required Qualifications and Competency Profile

- The ideal candidate will possess a deep background in materials science, strictly focused on the fundamental corrosion of metals.
- A Ph.D. in Materials Science and Engineering, Metallurgy, Chemistry, or a closely related physical science discipline, completed within the last five (5) years.
- Demonstrated expertise in investigating corrosion mechanisms of metallic systems under a range of environmental and solution conditions.
- Strong experience designing and executing laboratory experiments to study corrosion processes, including controlled electrochemical testing and environmental exposure studies.
- Hands-on laboratory experience with Electrochemical Impedance Spectroscopy (EIS) and Mott-Schottky Analysis
- Hands-on experience executing standard electrochemical corrosion tests, specifically potentiodynamic polarization, galvanostatic polarization, potentiostatic polarization, corrosion potential, corrosion current density, and mass loss measurements.
- Proficiency in surface/sample preparation of metals for metallographic analysis and advanced microstructural characterization techniques, specifically Scanning Electron Microscopy- Energy Dispersive X-Ray Spectroscopy (SEM/EDS), Raman spectroscopy, X-Ray Photoelectron Spectrocopy (XPS), optical profilometry, optical microscopy, and ion chromatography.
- Familiarity with ceramic materials chemical characterization techniques such as X-Ray Diffraction analysis and X-Ray Fluorescence analysis.
- Experience with atmospheric corrosion and field exposure studies in marine environments, including sample design, deployment, and post-exposure analysis.
- Familiarity with accelerated corrosion testing methodologies and relevant ASTM and AMPP standards, particularly those related to corrosion rate measurements and chloride-induced corrosion in reinforced concrete systems.
- Experience with a range of corrosion cell configurations, including droplet, syringe, and flat cells.
- Demonstrated ability to develop experimental protocols, standard operating procedures (SOPs), and laboratory infrastructure.
- A strong record of scientific productivity, evidenced by publications in peer-reviewed journals.

Preferred Qualifications

- Knowledge of cement chemistry, including hydration and the complex pore solutions of traditional or alternative binders.
- Knowledge of the Point Defect Model for corrosion, and an understanding of how to obtain the relevant model parameters from laboratory measurements.

U.S. Citizen is Preferred

Privacy Act Statement

Authority: 15 U.S.C. § 278g-1(e)(1) and (e)(3) and 15 U.S.C. § 272(b) and (c)

Purpose: The National Institute for Standards and Technology (NIST) hosts the Professional Research Experience Program (PREP) which is designed to provide valuable laboratory experience and financial assistance to undergraduates, post-bachelor's degree holders, graduate students, master's degree holders, postdocs, and faculty.

PREP is a 5-year cooperative agreement between NIST laboratories and participating PREP Universities to establish a collaborative research relationship between NIST and U.S. institutions of higher education in the following disciplines including (but may not be limited to) biochemistry, biological sciences, chemistry, computer science, engineering, electronics, materials science, mathematics, nanoscale science, neutron science, physical science, physics, and statistics. This collection of information is needed to facilitate administrative functions of the PREP Program.

Routine Uses: NIST will use the information collected to perform the requisite reviews of the applications to determine eligibility, and to meet programmatic requirements. Disclosure of this information is also subject to all the published routine uses as identified in the Privacy Act System of Records Notices: NIST-1: NIST Associates.

Disclosure: Furnishing this information is voluntary. When you submit the form, you are indicating your voluntary consent for NIST to use of the information you submit for the purpose stated.