

PREP Research Associate

This position is part of the National Institute of Standards (NIST) Professional Research Experience (PREP) program. NIST recognizes that its research staff may wish to collaborate with researchers at academic institutions on specific projects of mutual interest, thus requires that such institutions must be the recipient of a PREP award. The PREP program requires staff from a wide range of backgrounds to work on scientific research in many areas. Employees in this position will perform technical work that underpins the scientific research of the collaboration.

Research Title: Accelerated Corrosion Studies of Reinforced Concrete

The Infrastructure Materials Group (IMG) is seeking a highly motivated Research Associate to be a part of the **Next-Generation Building Standards** initiative within NIST.

Degradation of reinforced concrete due to embedded steel corrosion remains a monumental challenge, with direct and indirect costs accounting for 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 integrate 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.

The National Institute of Standards and Technology (NIST) promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology to enhance economic security and improve our quality of life. Located in Gaithersburg, Maryland, NIST offers a collaborative, interdisciplinary culture where you will work alongside some of the world's leading scientists and engineers to solve critical national challenges.

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. As part of the Engineering Laboratory, the IMG focuses on predicting the service life of infrastructure components under real-world and accelerated weathering conditions.

We are specifically targeting a researcher with a rigorous background in developing **accelerated corrosion studies** to inform long-term modeling and prediction of degradation. The ideal candidate does not just run standard tests; they understand the thermodynamic mechanisms that drive durability and those that drive corrosion initiation and propagation. You should be comfortable moving between the wet lab (extracting and analyzing pore solutions) and the computer (modeling phase assemblages and quantifying uncertainty).

Experience with cement **pore solution chemistry** and concrete **transport properties**, such as determining the **Formation Factor** using **XRF for pore solution analysis** or modeling hydration kinetics using **GEMS/PHREEQC**, is a critical skill needed for this position. Experience designing and conducting

advanced electrochemical assessments of reinforcement steel to measure corrosion initiation and progression rates under varied solution properties and environmental conditions are required.

Key responsibilities will include but are not limited to:

The Research Associate will conduct advanced accelerated corrosion studies of steel embedded in concrete made with innovative cement binders to develop new metrology for assessing corrosion degradation in new and existing reinforced concrete structures.

Cement and Concrete Material Science

- **Advance Measurement Science:** Develop and validate novel test methods for characterizing alternative cementitious materials, with a specific focus on linking microstructural development to macro-scale transport properties.
- **Pore Solution Characterization:** Lead efforts to standardize **X-ray Fluorescence (XRF)** techniques for the elemental analysis of concrete pore solutions, establishing protocols for characterizing accuracy and repeatability.
- **Durability Modeling:** Apply **thermodynamic modeling** to predict phase changes (e.g., carbonation, chloride binding) in Type II and CSA cements under varying climate scenarios.

Corrosion Science

- **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.

Technology Transfer

- **Uncertainty Quantification:** Use advanced statistical frameworks (Bayesian inference, Monte Carlo simulations) to analyze experimental data, and to quantify the uncertainty in service-life predictions for code development.
- **Code & Standard Development:** Translate research findings into actionable proposals for ASTM and ACI committees, directly influencing the next generation of building codes.

Qualifications

Required

- **Education:** Successful candidates should have completed a Ph.D. in any one of Chemistry, Physics, Mechanical Engineering, Chemical Engineering, Civil Engineering, or Materials Science at the time of the position start date, with a focus on chemistry and material science of cementitious materials or corrosion.

- **Cementitious Materials Science Background:** Demonstrated experience conducting quantitative laboratory measurements on cementitious materials: X-ray diffraction (XRD), thermogravimetric analysis (TGA), isothermal calorimetry, scanning electron microscopy (SEM).
 - **Transport & Durability:** Demonstrated understanding of the **Nernst-Einstein relationship**, electrical resistivity measurements, and the determination of the **Formation Factor** in cementitious systems.
 - **Thermodynamic Modeling:** Proficiency with geochemical modeling software (e.g., **GEMS**, **PHREEQC**, or **Oli**) to simulate cement hydration and phase stability in low-carbon binders.
 - **Alternative Binder Expertise:** Demonstrated research experience with **Calcium Sulfoaluminate (CSA)** cements, **Type IL** cements, or alkali-activated materials.
- **Corrosion Science Background:** 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
 - 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.
- A strong record of scientific productivity, evidenced by **publications in peer-reviewed journals**.

Preferred

- **Quantitative Phase Analysis (QPA) using X-ray Diffraction**, including the use of the **Internal Standard Method** to quantify amorphous contents in hydrated cementitious systems.
- **Composition Analysis using X-ray fluorescence** to quantify the elemental composition of solutions.
- 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 Spectroscopy (XPS)**, **optical profilometry**, **optical microscopy**, and **ion chromatography**.

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 the information you submit for the purpose stated.