**Nano-meter Coatings Based on 2D Materials for Microbial Corrosion Application**

**Govind Chilkoor**

**Civil & Environmental Engineering Department**

**SDSM&T**

**Abstract:** The annual costs for the direct and indirect effects of metallic corrosion on infrastructure have been reported to reach nearly $1 trillion in United States. Microbial corrosion accounts for nearly 20-40 % of the total corrosion costs. While there are several protective coatings available for metal protection, the commercial coatings tend to fail in the aqueous and microbial environments. The central goal of this project is to investigate a new class of minimally invasive (thickness of few nanometers), pin-hole-free, robust, and protective coatings made from conformal graphene or hexagonal boron nitride for use against microbial corrosion. This project enables the rational design of the next generation of minimally invasive, nanometer-scale, microbial-corrosion resistant coatings featuring building blocks based on 2D materials. Here we will share the preliminary results of chemical vapor deposition (CVD) grown single layer two dimensional (2D) hexagonal Boron nitride (SL-hBN) as a nanoscale corrosion barrier for MIC by sulfate-reducing bacteria *Desulfovibrio alaskensis* G20 (SRB-G20). Transmission electron microscopy, Raman spectroscopy and optical micrographs confirmed the presence of single layer hBN on copper foil (SL-hBN-Cu). Defect density due to grain boundaries and point defects in SL-hBN coating on Cu were characterized using oxidation experiment (air annealing and hydrogen peroxide). A series of electrochemical tests (AC and DC methods) confirmed the excellent passivation effects of hBN coating. At the end of 24 days of exposure, the polarization resistance (Rp) obtained from linear polarization resistance (LPR) test were 9 times higher for SL-hBN-Cu compared to bare Cu. The corrosion rates calculated from LPR analysis was 87% lower for SL-hBN-Cu compared to bare Cu. The capacitance values obtained from electrochemical impedance spectroscopy (EIS) were one order of magnitude lower than bare Cu suggesting that the SL-hBN acts as an impermeable physical barrier to minimize pathways to that relay aggressive metabolites (*e.g.* H2SO4 and HS-) from contacting Cu surface. The inhibition efficiency of SL-hBN coating obtained from EIS test was as high as 91% which is close to commercially available polyaniline. In addition to impermeable behavior of hBN coating its insulating nature also suppressed galvanic corrosion by 400 times compared to graphene.

**Biography**: Govind Chilkoor has a BS and MS degrees in Chemical Engineering. After nearly 15 years of extensive experience in industrial and research aspects of chemical and environmental engineering, Govind has returned to graduate school to pursue PhD in the Civil and Environmental engineering at the South Dakota School of Mines and Technology. Currently, he is a PhD candidate and plans to graduate in 2019. He is developing next generation, two-dimensional (2D) material protective coatings to combat microbial induced corrosion. Govind has worked in three different multinational companies including Archer Daniels Midland, Iowa, USA, DuPont Singapore Pte Ltd, Singapore, and ITC Ltd., India. Examples of his project work are related to biofuel (ethanol), soya bean and cotton seed oil solvent extraction, Lecithin and Acid oil plant production, Starch and Fibersol, solar desalination of brackish water and R&D aspects of polyester fiber bi-component yarn.

**When: Tuesday, November 13, 2018 at 4:00 pm**

**Where: EP252**