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### Benchmarking Stability of Nitrate-Sensing Materials

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In Missouri over \$100 million dollars of nitrate fertilizer is lost due to water run off every year. This nitrate collects in the water which can cause environmental damage such as algal blooms and economic losses in Missouri communities. Current nitrate sensing methods use liquid chromatography-mass spectrometry measurements which are both timely and costly. Advanced nitrate sensing materials used in electrochemical sensors have the potential to be more effective and low cost to better detect nitrate in the environment. The material we are testing is Nitrate ionophore VI because it can selectively bind nitrate. We are studying how this membrane can be integrated into an electrochemical sensor, and under what conditions it works and fails as a sensor. To benchmark this material, we conducted electrochemical testing including open circuit voltage and impedance measurements at different concentrations of sodium nitrate ( $\text{NaNO}_3$ ). We created an ion selective membrane (ISM) by mixing polyvinyl chloride (PVC) and nitrate ionophore VI and then drop casting the solution on pyrolytic graphite sheet (PGS). We found that both the open circuit voltage and charge transfer resistance using this ISM were inversely proportional to the logarithm of the  $\text{NO}_3^-$  concentration and exhibited near-Nernstian behavior. We studied the effect of membrane thickness on sensing capabilities and found that an increased thickness yields an improved performance. We found that introducing a polypyrrole (PPy) film between the PGS and ISM reduced the thickness of the ISM needed to form a functional sensor thus reducing cost of material. This relationship indicates that the ISM polymer shows promise as a potential alternative to current sensing methods. Future studies should focus on ability to sense at higher concentrations and stability in a real-world water stream setting.