

Towards Continuous *in situ* Sensing of Marine Pollutants Using Surface Enhanced Raman Spectroscopy (SERS)

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Excess concentrations of nitrate and phosphate in seawater can lead to harmful algae blooms that damage coastal ecosystems, pose health risks and adversely impact commercial activity. Early *in situ* detection of over-nutrication is necessary for rapid response and mitigation plans.

Commercial nitrate and phosphate sensors utilize UV-Vis spectroscopy and are generally incapable of detecting at limits set by the U.S. Environmental Protection Agency (EPA), necessitating new approaches for *in situ* monitoring. Surface enhanced Raman spectroscopy (SERS) is a technique theoretically capable of single molecule detection, and therefore may be a promising approach for nitrate and phosphate detection. However, there are clear challenges as SERS sensing is negatively affected by interference in complex media and *in situ* sensing in a solution phase reduces accuracy and resolution. It is because of these challenges, in part, why much of the data reported in the literature are taken for purified samples that are then dried on a SERS substrate.

Our goal is to address the engineering challenges for a SERS *in situ* seawater nutrient concentration measurement system. Batch and flow-through devices have been designed to incorporate commercially available, nanostructured gold SERS substrates. By benchmarking against 4-nitrobenzenethiol/ethanol solutions, our results show that SERS devices can be used as a development platform for a seawater nutrient sensor. They also depict the challenges associated with complex media and provide insight into surface modification strategies needed to selectively detect nitrate and phosphate.