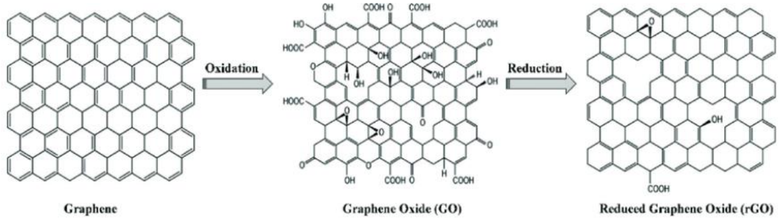
Check the Adsorption Efficiency of Macronutrients over Graphene and its Oxidized Derivatives

Abhishek Kumar, Civil, Environmental and Sustainable Engineering Mentor: Francois Perreault, Assistant Professor
School of Sustainable Engineering and Built Environment

Introduction

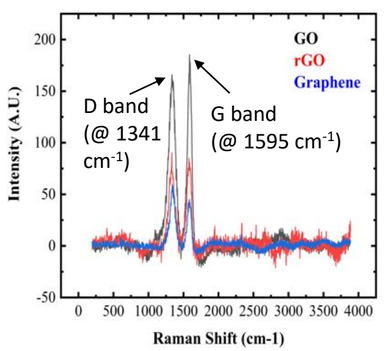
There are several disadvantages associated with the use of conventional fertilizers, like low productivity, nutritional deficiency, soil acidification, eutrophication, etc. One of the solution can be Nano-fertilizers mediated agriculture. In this project, we will be checking the efficiency of the adsorption of the macro-nutrients(namely N, P, K) over three different types of Graphene and its oxidized nanomaterials, namely Graphene(Gr), Graphene Oxide(GO) and reduced Graphene Oxide(rGO). For this lab base study, the adsorption capacity was checked at different loading conditions of the macronutrients. The overall aim of the project is to check the efficiency of the macro-nutrient getting adsorbed over the Graphene nanomaterials-based platform.

Materials

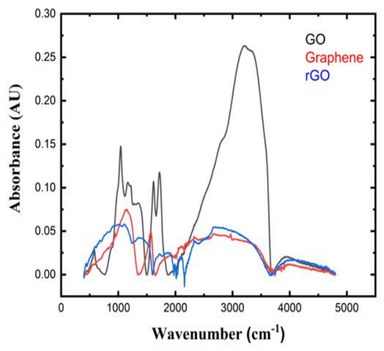


Results and Discussions

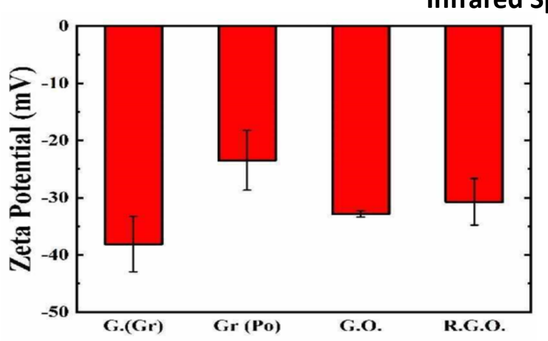
Characterization of Graphene and its Oxidized forms



Raman Spectroscopy

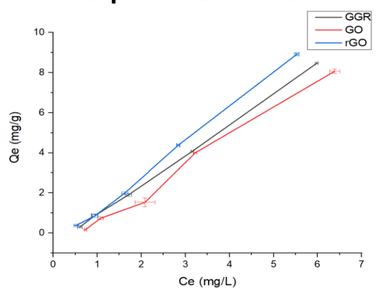


Fourier Transform Infrared Spectroscopy



Zeta Potential to check the stability

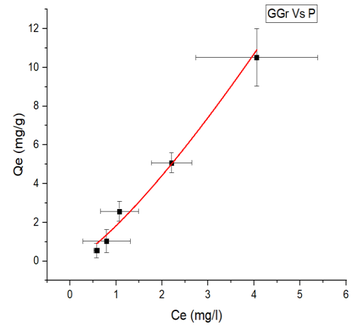
Adsorption Results for Macronutrient Nitrate

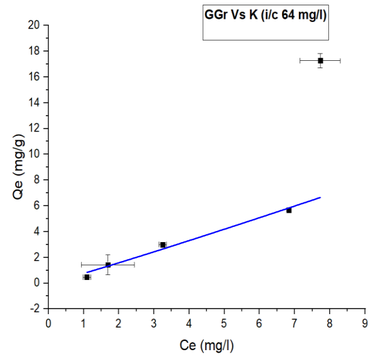


As the concentration of Nitrate is increasing, the adsorption by Graphene based nano-material is increasing linearly

Results and Discussions

Adsorption Results for Macronutrient (P, K) for Graphene





Conclusions

- From the experimental data, it can be observed that as the concentration of the nutrient is increasing, the adsorption by the Graphene nano-materials is increasing accordingly, this can be attributed to higher surface area, higher area-to-volume ratio, surface chemistry, etc. of Graphene as nano-material.
- Similar results can be anticipated for adsorption of macronutrients over GO and rGO nano-materials

References

- Ivan B. Andelkovic, Shervin Kabiri, Ehsan Tavakkoli, Jason K. Kirby , Michael J. McLaughlin, Dusan Losic, “Graphene oxide-Fe(III) composite containing phosphate e A novel slow release fertilizer for improved agriculture management”

MORE
Masters Opportunity for Research in Engineering

Ira A. Fulton Schools of Engineering
Arizona State University