Research Theme 1: Materials Scale

Research Theme 2: Human-Technology Scale

Exploring Hybrid LIG-Nanoparticle Combinations as a Phosphorous Sensing Material

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Introduction

Phosphorus (P) is an essential element for all life forms and a finite resource. However, risks of ecological destabilization occur from mining phosphate rock in excess amounts considering P naturally occurs in limited quantities. Excess P-based chemicals, such as fertilizers, pesticides, and detergents, introduce various P forms into the environment. Much of the excess P in environmental systems is in a form that is not bioavailable for plant uptake, leading to nutrient pollution, such as the eutrophication of water bodies. Nutrient pollution is a rampant issue that affects countless environmental systems. Current analytical tools for phosphorous monitoring are highly variable and costly, affecting the viability of real-time sensing. Knowledge integration should be a leading concern when implementing change in local communities most susceptible to nutrient pollution. Developing a cost-effective, real-time sensing system widely available for monitoring P levels in soil and water is critical for environmental stability.

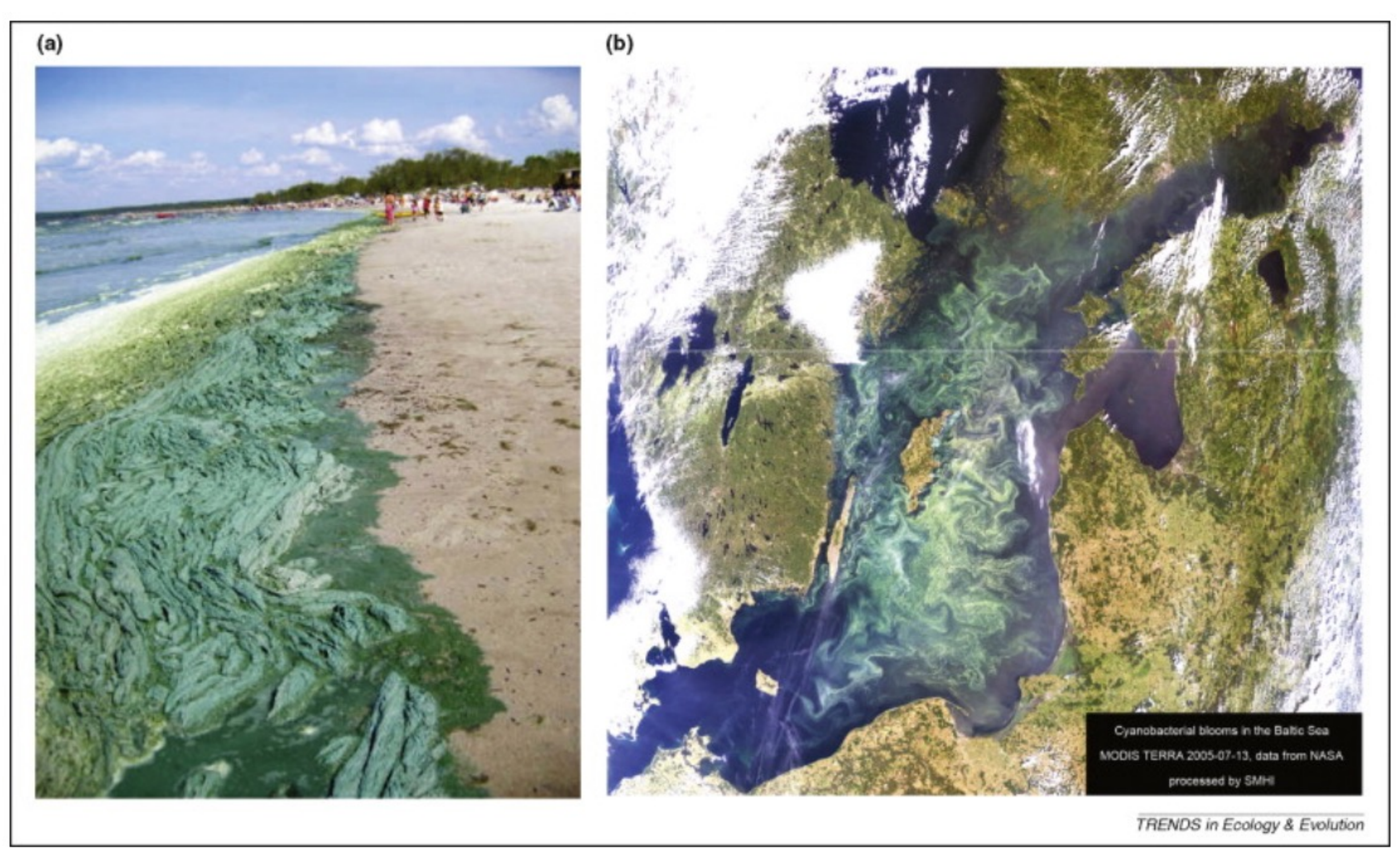


Figure 1: (a) Showcases eutrophication on the Baltic coast. (b) NASA image showing nutrient pollution from space.

Research Goal

To Explore hybrid LIG-nanoparticles combinations as a phosphorus sensing material.

Methods

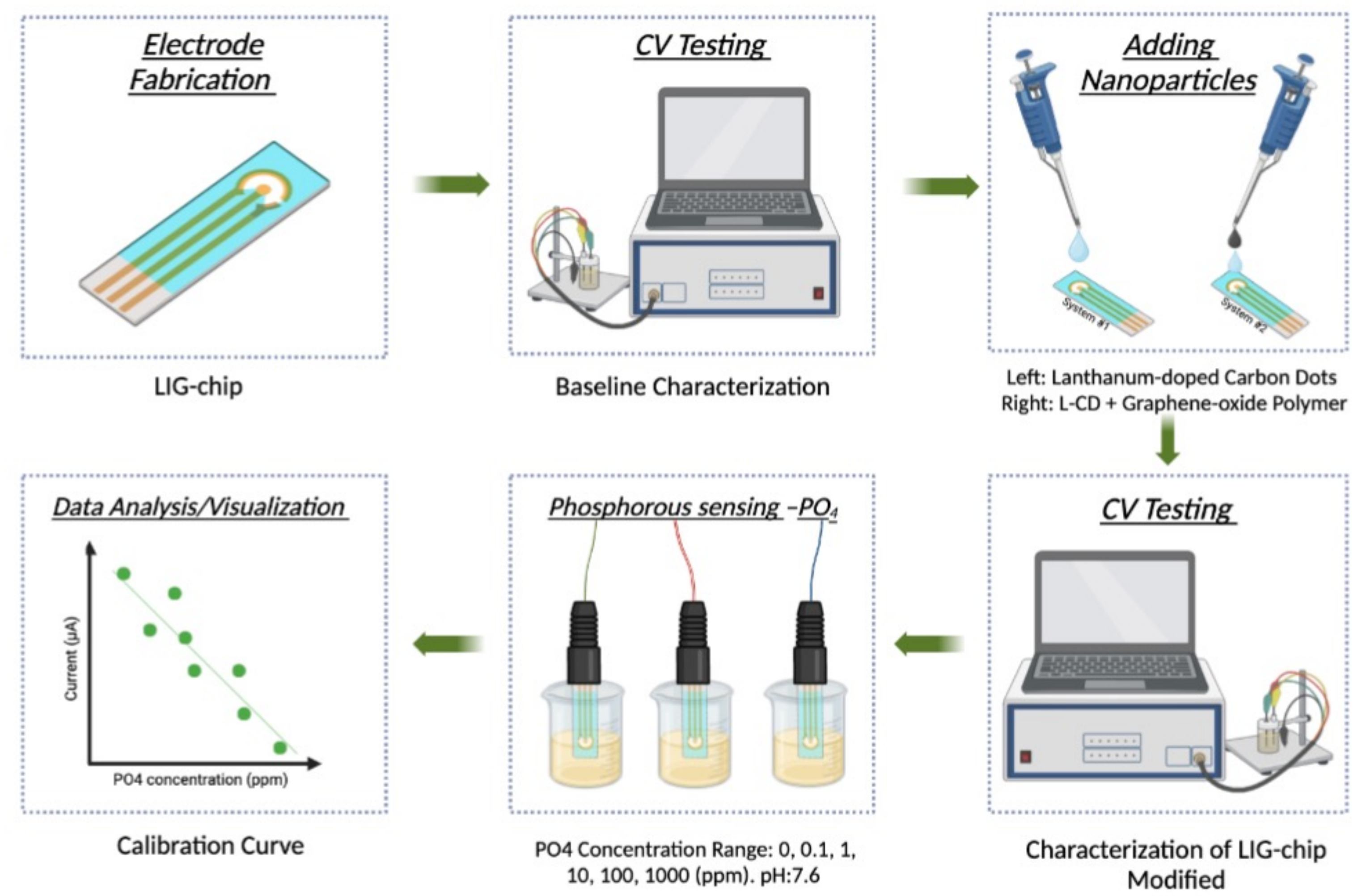
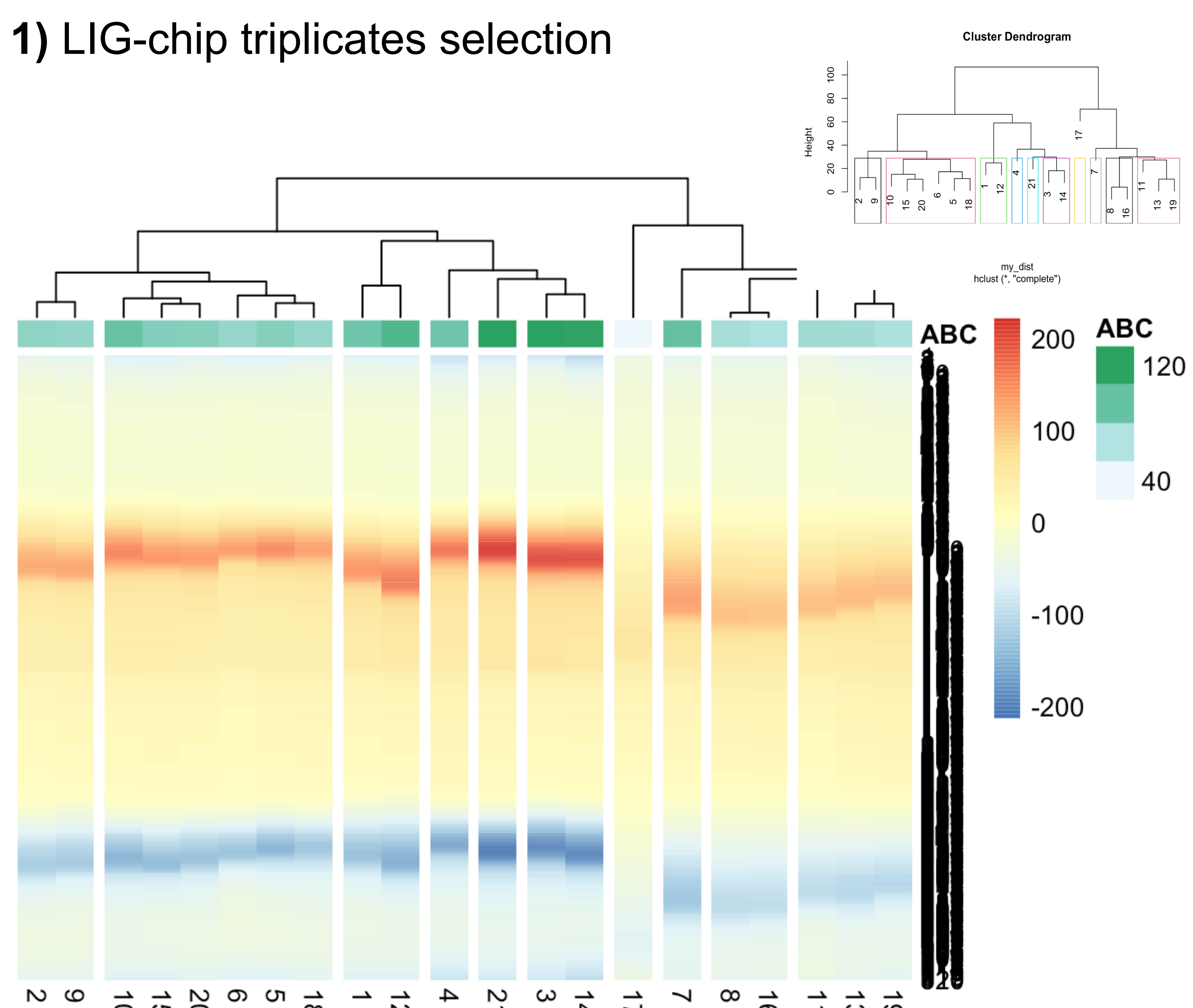


***Figure 2:** Selection of similar LIG-chips from batch fabrication, Baseline LIG-chip characterization (without nanoparticles), Drop-cast nanoparticles on LIG and characterize electrochemical behavior, Phosphorous sensing – PO_4 standard solution and TBL water samples, Data analysis.*

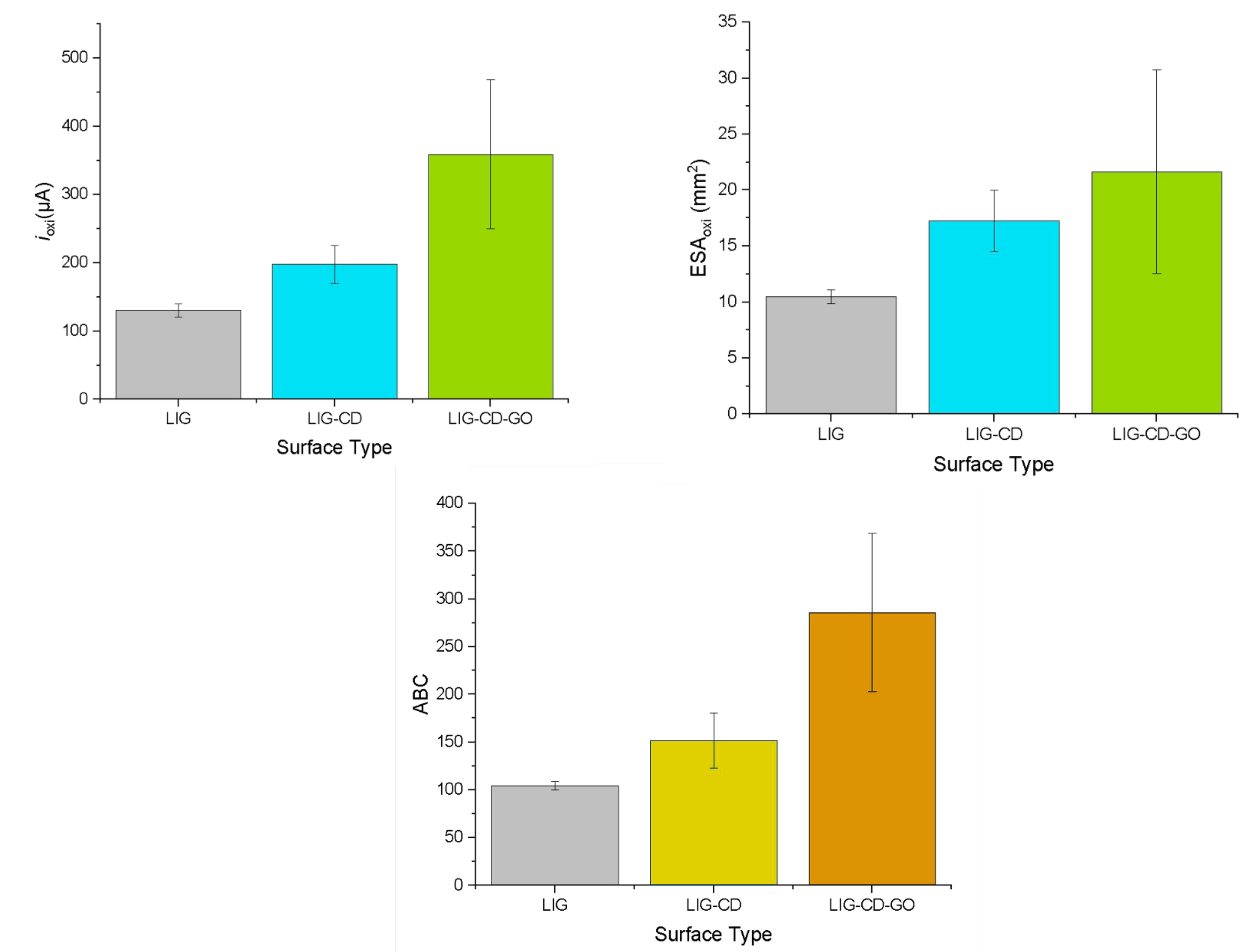
Results

1) LIG-chip triplicates selection

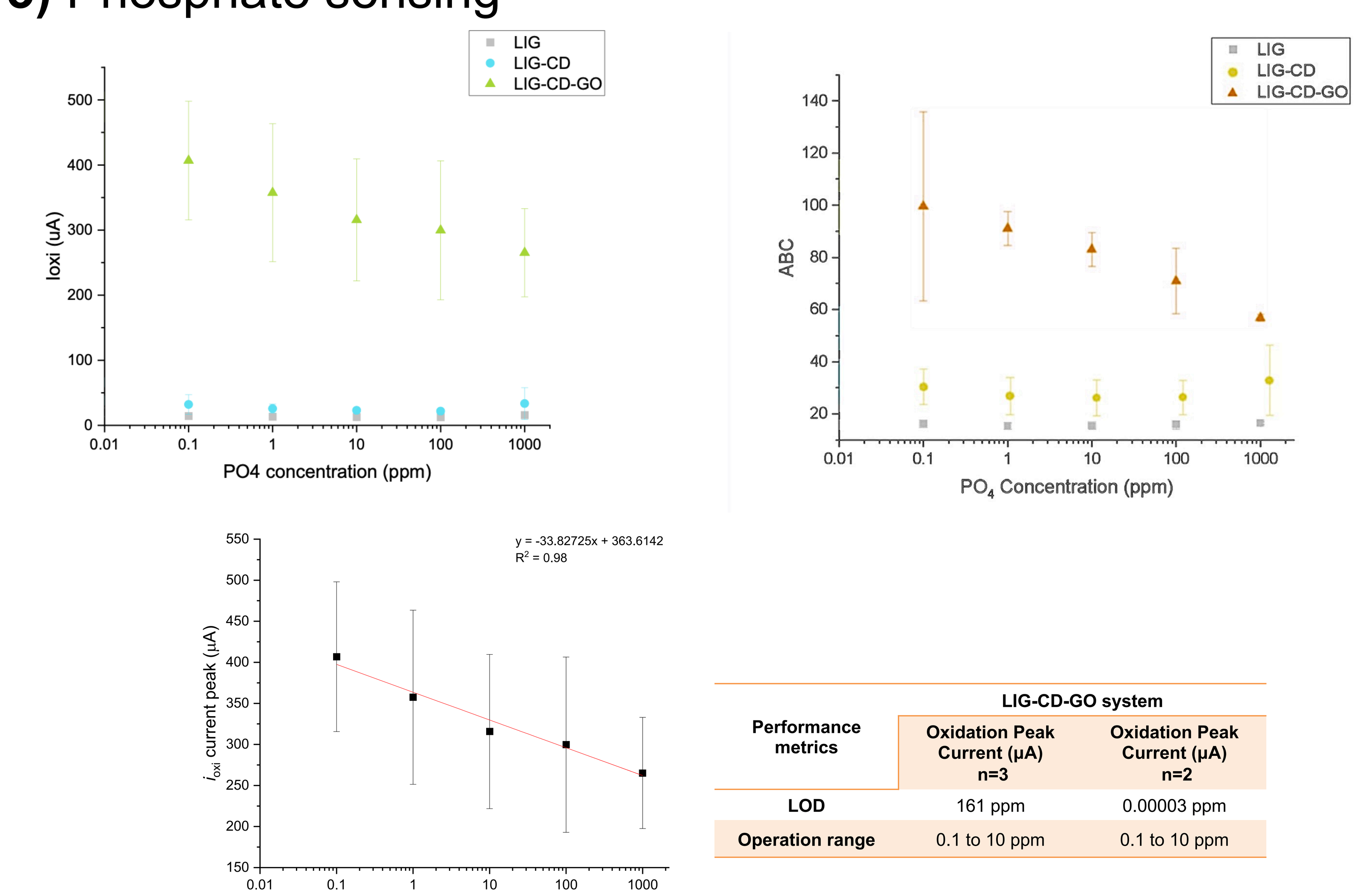


Results

2) Sensor functionalization



3) Phosphate sensing



Performance metrics	LIG-CD-GO system	
	Oxidation Peak Current (μA) n=3	Oxidation Peak Current (μA) n=2
LOD	161 ppm	0.00003 ppm
Operation range	0.1 to 10 ppm	0.1 to 10 ppm

Conclusions

Hybrid LIG-nanoparticles may be an effective material for PO4 sensing. Layering Lanthanum-doped carbon dots and Graphene-oxide PolyDADMAC showed a linear response when detecting phosphorus

Acknowledgements
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