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Optimization of Additively Manufactured Graphene-Enhanced Geopolymer Concrete

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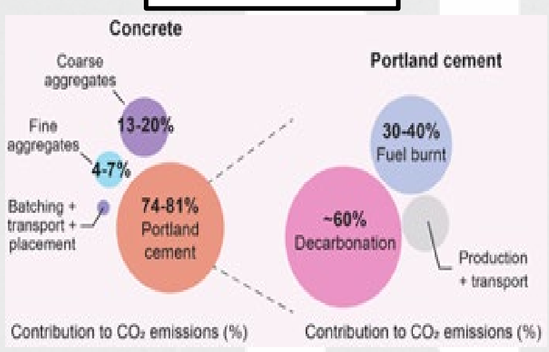
Abstract

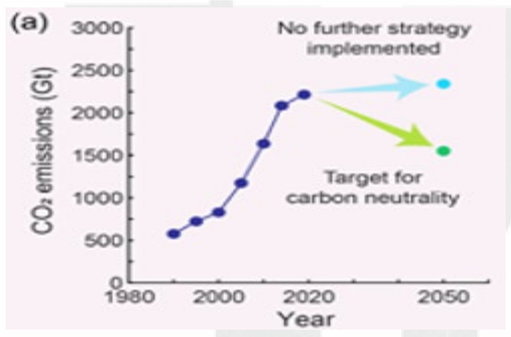
This project will develop a high-performance graphene-enhanced geopolymer concrete optimised for additive manufacturing applications. Mix designs employing the additives GGBS, Fly ash, and Metakaolin will be combined with a graphene nano additive to enhance the strength and electrical properties. The activation process will be carried out using sodium hydroxide with a concentration of 10 Molarity, and components of each geopolymer formulation will be combined using a Hobart mixer. Test specimens will be manufactured via an extrusion based additive manufacturing process utilising a Universal Robots UR10e Collaborative Robot Arm attached to the duct of the auger concrete pump. Key challenges will involve the optimisation of a suitable desired open time, fresh state properties, buildability, and shape retention. Mechanical properties of the printed components including compressive and flexural strength will be measured, and in addition the electrical properties (bulk resistance, conductivity, dielectric permittivity) will be evaluated using impedance spectroscopy to evaluate the 3D-printed geopolymer concrete.

Keywords: 3D concrete, Geo-polymerization, Sustainability, Additive Manufacturing, Graphene

Problem

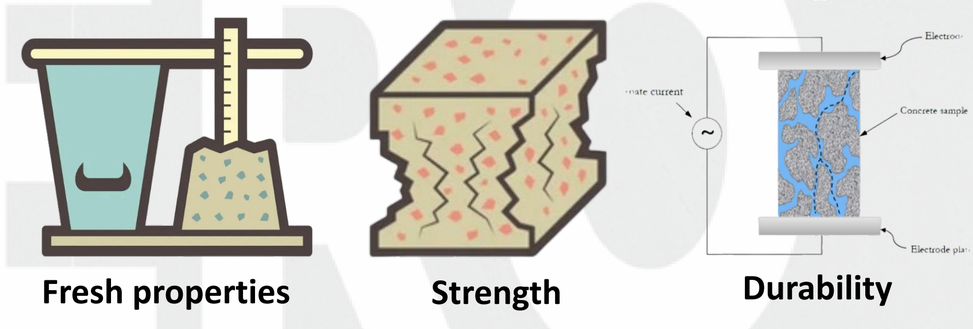


Aim



Objectives

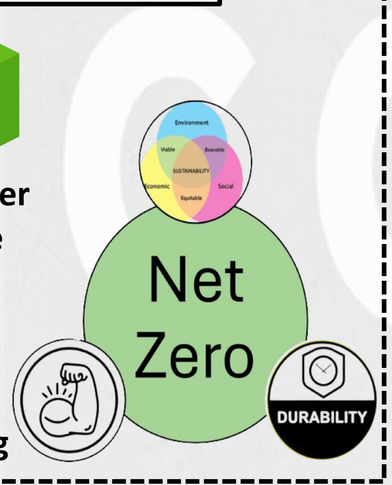
1. Fresh properties
2. Strength
3. Durability



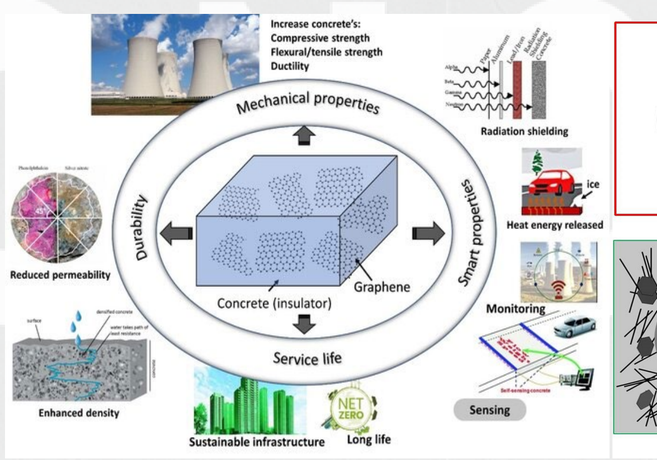
Solution

Geopolymer Concrete

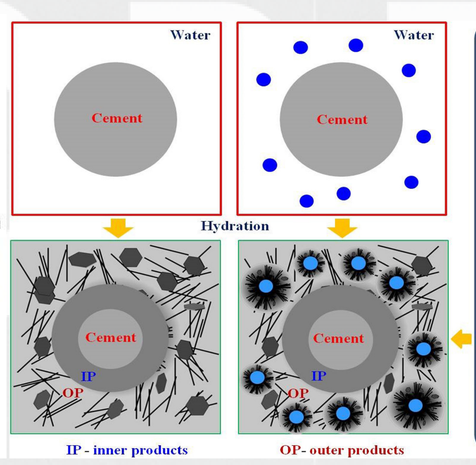
3D Printing



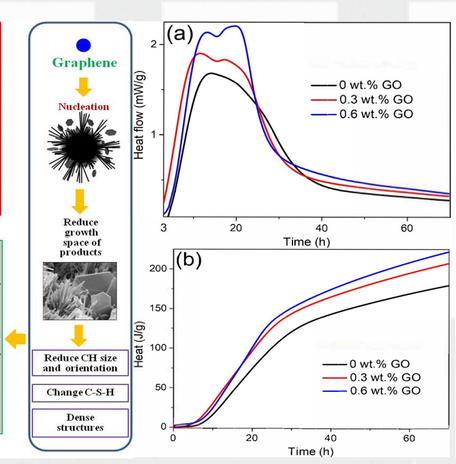
State-of-the-art



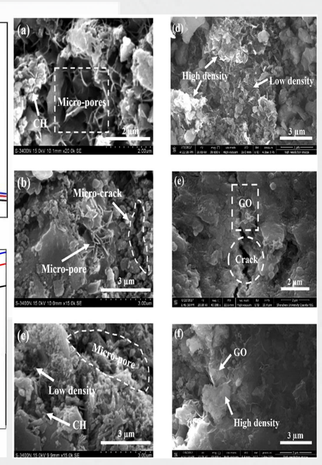
Mechanism



Kinetics

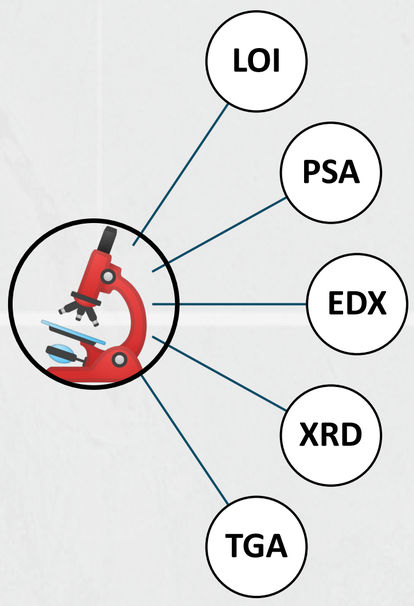


Structure

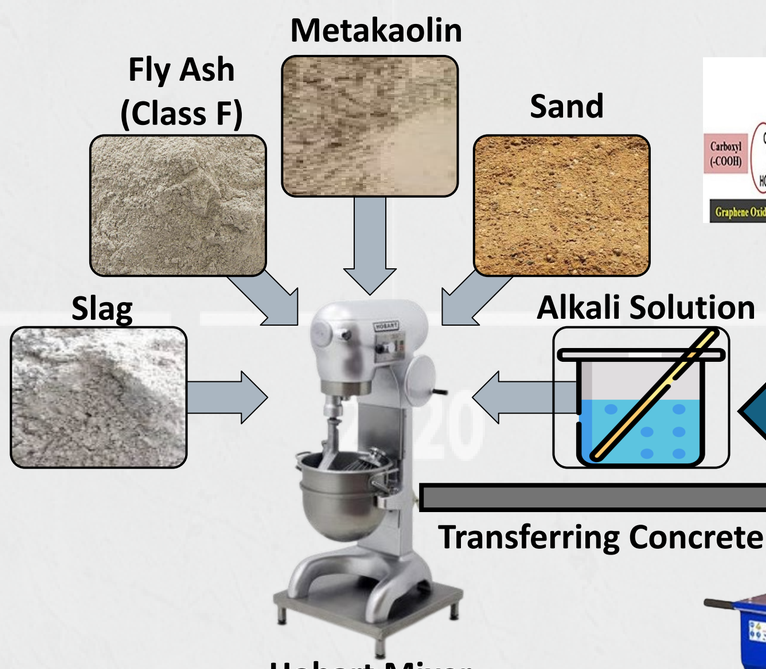


Methodology

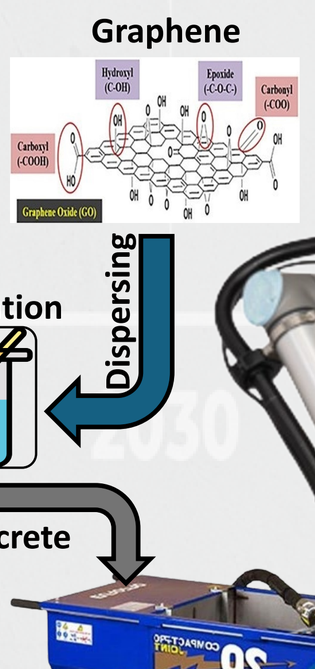
Material Characterization

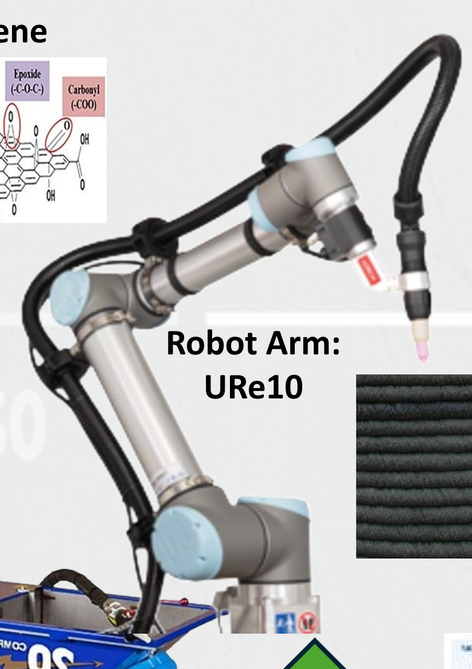


Binder Formulation



Extrusion





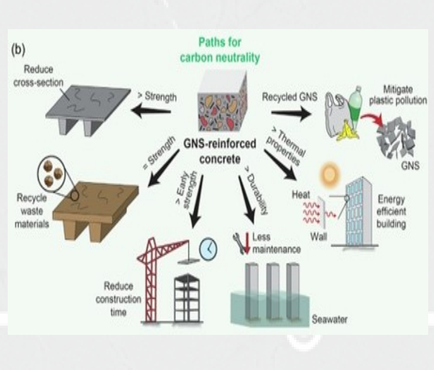
Robot Arm: URe10

Concrete Pump

Modelling > Slicing > GCODE

Process

Research Expectations



Performance Evaluation

References

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