Strengthening Chloroplasts Through Polymerization Pathways

Katherine Malloy, Chemical Engineering
Mentor: Dorsa Parviz, Assistant Professor
School for Engineering of Matter, Transport and Energy

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Research Goal

Using chloroplast-derived sugars to make synthetic polymers outside of the plant cell.

Abstract

Chloroplasts can be isolated, and outside the plant cells, they can fix CO2 into various sugars. These sugars can be extracted and co-polymerized with other monomers to make synthetic polymers fixed from atmospheric CO2. This provides a platform for sustainable production of polymers using renewable carbon sources and relying only on sunlight energy to drive the reaction. Challenges associated with this are designing sugar-derived polymerization pathways that can occur in ambient conditions. In addition, we must extend chloroplast shelf-life outside plant cells. We're addressing the first challenge here.

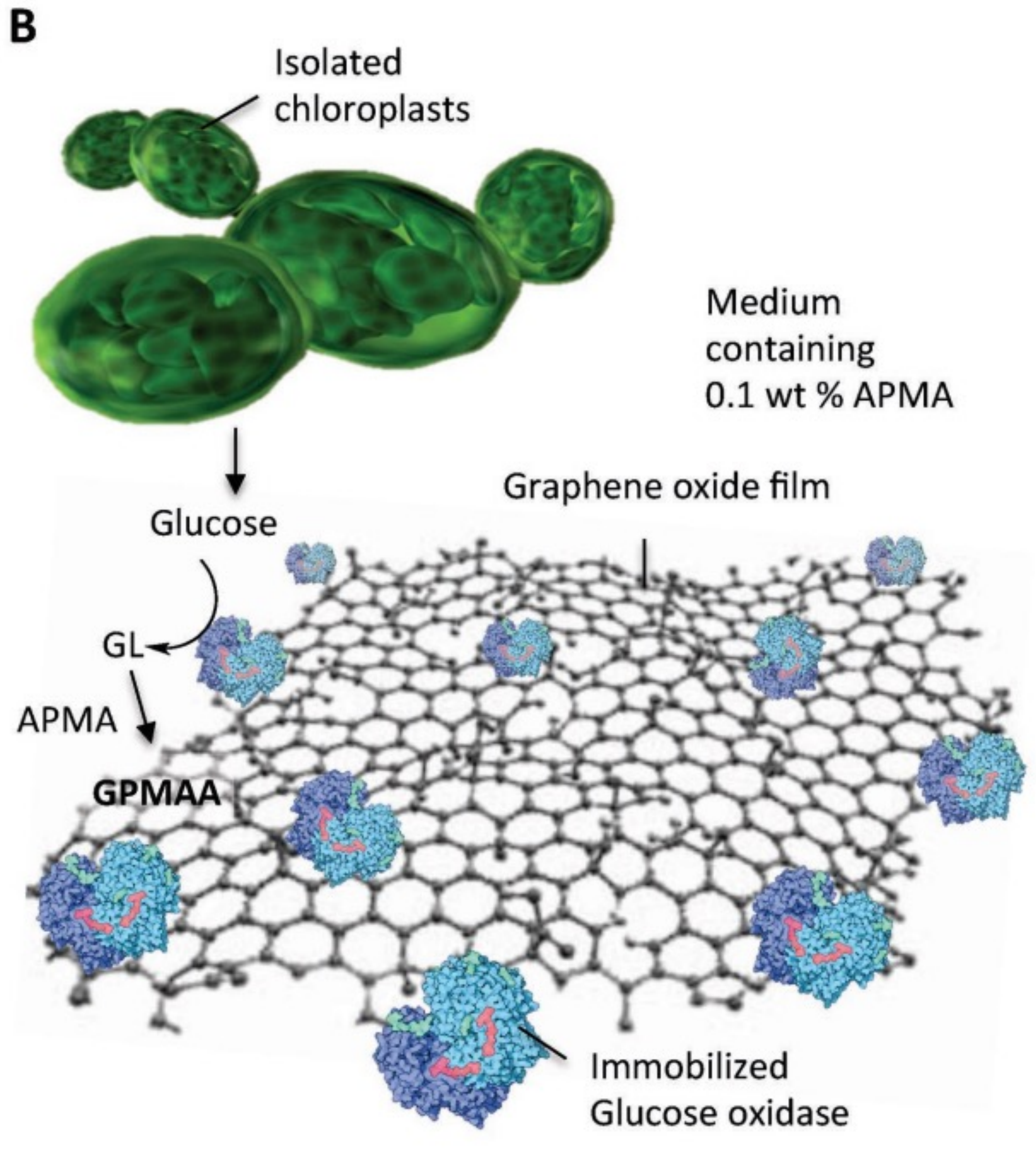

Figure B:
An overview of how to create polymers with chloroplasts and sugars

Kwak, Seon-Yeong, et al. "Polymethacrylamide and carbon composites that grow, strengthen, and self-repair using ambient carbon dioxide fixation." *Advanced Materials*, vol. 30, no. 46, 9 Oct. 2018, https://doi.org/10.1002/adma.201804037.

Possible Polymerization Pathways

- Can use one of three sugars – maltose, glucose and fructose
- These sugars are then converted into chemical groups like alditols, amides, or urethane
- These create sugar compounds
- The steps are to isolate the chloroplasts, then mix the sugar, MMA, and enzyme to form a polymer

Next Steps

The goal is to separate the chloroplasts, and then test each possible polymerization pathway. This research will be completed next semester.
Separation of chloroplasts is shown to the left.

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Ira A. Fulton Schools of Engineering
Arizona State University