Electrolysis of 3D Polylactic Acid (PLA) for Custom Fabrication of Sustainable Electromagnets

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Plastic based magnets and circuits are an innovative idea to create a more sustainable electronics ecosystem. Additionally, custom fabricated electromagnets could certainly create new types of solenoids at a lower cost than regular electromagnets. Printed polylactic acid (PLA) cubes underwent a multi-stage electrolysis process to coat them in layers of copper, iron, and zinc. The cubes were etched for varying times for varying concentrations of NaOH. The cubes then underwent copper, iron, and zinc electrolysis where voltage, concentration, and time in solution were isolated and tested. The electromagnetic cubes were tested for their magnetic strength at varying voltages, resistance, and efficiency of formation to find the best condition from each category. Once the ideal value from each variable was found, the ideal variables were combined to make the ideal electromagnet. It was found that cubes that were in an electrolytic cell for 80-120 minutes that consisted of 1M copper sulfate with a voltage of 2V had the lowest resistance and superior ability to plate additional layers. The ideal copper cubes were then put in an electrolytic cell of 1M iron chloride for 60 minutes at 1V to form an iron plate around the copper to make the ideal iron-copper cube. Ideal zinc plating at 1M zinc chloride and 2V at 10 minutes enabled a durable outer layer. The ideal cube was able to produce a magnetic force of 0.0098N at 5 watts and a coil shape produced a magnetic force of 0.1078N at 5 watts.

Awards Won:

Second Award of $2,000

YM American Academy: First Award of $3,000