Optimizing Graphitic Carbon Nitride to Create a Safe, Effective, and Economic Form of Hydrogen Storage

Novoa, Valeria (School: James Madison High School)

In recent years, more renewable and clean forms of energy have emerged, among them is hydrogen energy. While it is an advantageous option, its downside, which prevents it from being more commonly used, is its ability to be stored. This research explores the different ways the cheap and abundant resource of urea fertilizer can be modified to optimize its hydrogen storage capacities. The hypothesis was that if graphitic carbon nitride is doped with carbon, then it will produce the most effective form of hydrogen storage. For this research, three different materials were created: pure graphitic carbon nitride, carbon-doped graphitic carbon nitride, and metal-doped graphitic carbon nitride. Using an airtight chamber engineered for the experiment, each material was individually placed inside and filled with hydrogen gas obtained through electrolysis. Through this process, the materials were able to absorb hydrogen and retain it at ambient temperature. Pre-post analysis was conducted by measuring the weight change of each material before and after hydrogen exposure. All materials increased in weight, indicating hydrogen absorption. Metal-doped graphitic carbon nitride absorbed less than 1% of its original weight in hydrogen, while pure graphitic carbon nitride and carbon-doped graphitic carbon nitride absorbed 2% and 4%, respectively. This study proved carbon-doped graphitic carbon nitride to be the most effective in storing hydrogen out of the three materials. Further research could involve doping graphitic carbon nitride with other nano-particles to further increase storage capacities.

Awards Won:
Third Award of $1,000