Public Abstract

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In recent years, there has been a great emphasis on replacing fossil fuels with clean, renewable energy for use in vehicles. Before a change from fossil fuels to hydrogen can occur, there must be significant progress in developing low pressure hydrogen storage systems. To solve this problem, many researchers are investigating new, innovative materials to reduce the internal pressure of the fuel tank while simultaneously storing more gas than compressed hydrogen tanks. Cryogenic hydrogen and materials such as metal hydrides, chemical hydrides, and adsorbants such as carbonaceous materials and Metal Organic Frameworks (MOFs) have shown promise. However, none are currently able to fully meet the US Department of Energy requirements.

My research focuses on using activated carbon made from corn cob as a hydrogen storage material. Activated carbons have the potential to be excellent storage systems for hydrogen gas because of their high surface areas, reversible hydrogen storage capabilities, and low production cost. However, limitations on the surface area and hydrogen binding energy restrict their effectiveness as a potential storage material. It has been shown that boron-doped carbon materials may have an increased binding energy compared to undoped carbon. Boron-doped activated carbons were produced using vapor deposition and pyrolysis of a Decaborane followed by high temperature annealing. Room temperature hydrogen adsorption experiments show a 20% increase in the hydrogen adsorption per surface area. Experimentally determined adsorption enthalpies showed that the boron-doped activated carbon had an adsorption enthalpy of ~9-10 kJ/mol compared to 6 kJ/mol for the precursor.