Activated carbon powder is applied to the electrodes of supercapacitors.

In previous literature, carbon spheres synthesized from pure refined sugar have been studied and were found to be hollow. For this work, carbon spheres were instead synthesized from raw unrefined cane sugar from Puerto Rico, a cheaper alternative. This resulted in the spheres being solid. The purpose of this research was to characterize this new material and understand its electronic transport properties so that it may be applied in electronic devices, like the electrodes of Electric Double Layer Supercapacitors.

**Motivation**

In previous literature, carbon spheres synthesized from pure refined sugar have been studied and were found to be hollow. For this work, carbon spheres were instead synthesized from raw unrefined cane sugar from Puerto Rico, a cheaper alternative. This resulted in the spheres being solid. The purpose of this research was to characterize this new material and understand its electronic transport properties so that it may be applied in electronic devices, like the electrodes of Electric Double Layer Supercapacitors.

**Specific Surface Area**

- The specific surface area was determined by measuring the amount of adsorbed $N_2$ gas on the surface of the spheres, in accordance with BET theory.
- The amount of gas was measured using a volumetric procedure.
- The carbon spheres were found to have a specific surface area of 4.0 m$^2$/g, a value that implies the sample has very low specific surface area and is nonporous.

**Characterization**

**Electron Transport**

- PPMS was used to measure the temperature dependence of conductivity.
- The conductivity of the material was at maximum of 0.2196 Siemens/cm at 296K.
- Theoretical model developed by the University of Puerto Rico showed that main methods of electron transport are variable range hopping and electron tunneling.

**Raman Spectroscopy**

- Disordered graphite: 1350 cm$^{-1}$
- Crystalline graphite: 1600 cm$^{-1}$
- The ratio of crystalline graphite to disordered graphite is the tendency towards the material’s crystallinity.
- Heat treatment will increase crystallinity and thus conductivity.

**Conclusion**

Activated carbon powder is applied to the electrodes of supercapacitors.

- Solid spheres were more conductive at room temperature than the hollow spheres.
- They were found to have the same composition as the hollow spheres, despite a different cheaper starting material.
- Solid spheres had very low specific surface area and therefore low specific capacitance, so the spheres can be mixed with other high surface area materials to create a compound with both high conductivity and high surface area.

**Future Work**

The spheres will be annealed at higher temperatures to increase their conductivity.

**References**

* Electron transport mechanisms in polymer-carbon sphere composites. (Nieves et al, 2016)
† Murata.com (2016)