The synthesis of carbon material from biomass for energy conversion and storage

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Energy has been one of the world's biggest concerns due to rising consumption and demand with the increase in population. The intensive use of fossil fuels to meet energy needs includes global warming due to CO_2 emissions and climate change due to global warming. The answer to halting climate change is renewable energy, and this strategy must be sustainable. The fact that intermittency of renewable energy sources such as wind and solar makes it necessary to design these systems in integration with energy storage systems.

One of the keys to the development of the next generation of biocompatible energy storage and conversion technologies lies in both finding new materials and understanding these materials' behaviors. Among the exploited energy materials, biomass-derived carbon, as a type of electrode catalyst materials, has attracted much attention due to its structural diversities, high electronic conductivity, adjustable physical/chemical properties, environmental friendliness, and significant economic value [1]. It has been reported that lignocellulosic biomass obtained from agricultural and forest residues is a suitable source for conversion into carbon materials [2]. Lignocellulosic biomass is rich in carbon and other important additives and, as a result, can contribute to the development of sustainable processes. In this study, hawthorn *(Crataegus Orientalis)* cores, which are agricultural waste, were used as raw materials to produce activated carbon.

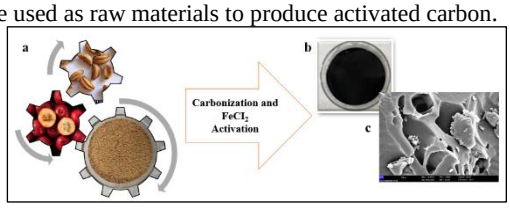

Figure 1. a) ground hawthorn cores b) activated carbon c) FE-SEM image of activated carbon

Firstly, hawthorn cores were carbonized by pyrolysis in an inert condition, resulting in a solid residue with increased carbon content. Prior to activation, biochar was impregnated with $FeCl_2$/ethanol solution in a 1:10 mass ratio ($FeCl_2$:Biochar). After 30 minutes of impregnation, filtrated, and then the mixture was dried in a vacuum drying oven at 80 °C to ensure complete drying. Finally, it was kept under N_2 flow for 1 hour with a temperature increase of 800 °C and 5 °C/min, and the active carbon obtained as called HS-AC.

The synthesis diagram of HS-AC was exhibited in Figure 1. The morphology of HS-AC was characterized via a Field Emission Scanning Electron Microscopy (FE-SEM) and the images obtained from this analysis was given in Figure 2. As is seen from this figure, HS-AC showed a well-developed porous structure. The activation process resulted in the formation of pores and the significant removal of inorganic material. Also according to the FE-SEM EDX analysis, the composition of the elements in HS-AC was as follows: 95% for carbon, 0.26% for oxygen, 1.35% for chloride, and 0.41% for iron.

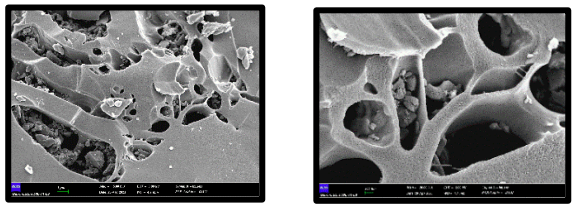

Figure 2. FE-SEM images of HS-AC

It can be concluded that $FeCl_2$ is a promising activating agent to prepare activated carbon with a developed porous structure. Consequently, HS-AC can be considered as carbon material with low-cost and eco-friendly. Furthermore, this material can be use as efficient electrocatalyst for energy storage and conversion technologies.

References

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