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JOINT DEVELOPMENT OPPORTUNITY

Nano-Carbon Foam for High Energy Density Supercapacitor Electrode and Carbon Capture and Storage Applications

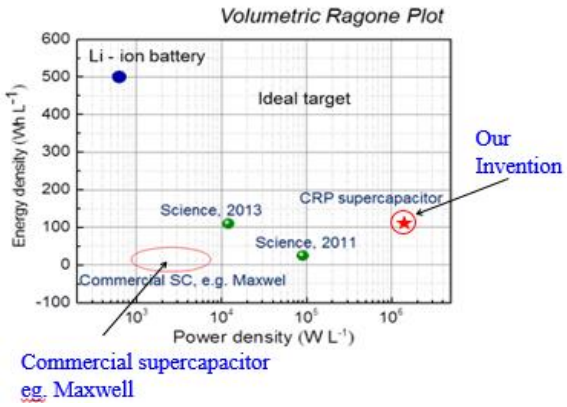

Fig. 1: Superior energy and power density achieved compared to commercial supercapacitors

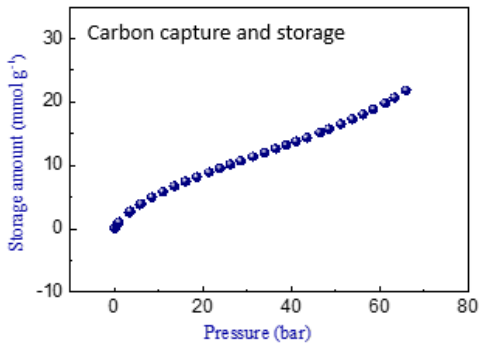

Fig. 2: Carbon capture and storage performance (0 – 65 bar)

TECHNOLOGY BACKGROUND

To achieve high performance in industry, supercapacitors need be to be made with materials that have high surface area, high material density and superior conductivity. However, the surface area and material density of a material vary inversely with each other. Porous materials have high surface area, but lack large material density. Therefore, its electrical conductivity is poor.

Another problem faced by manufacturers is that the de facto fabrication of supercapacitor electrodes/nano-carbon foam using chemical reagents is a complex multi-step process. It is time-consuming and expensive.

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Invention

A high surface area and highly conductive porous nano-carbon foam for supercapacitor electrodes as well as carbon capture and storage applications. . The nano-carbon foam is fabricated by a single-step process without chemical reagents. The conventional supercapacitor electrode is fabricated using activated carbon precursor and requires mixing with binders and conductive agents to bind the activated carbon particles together and increase its conductivity. In contrast, this nano-carbon foam does not require any binders or conductive additives due to the unique processing method used, resulting in a superior energy and power densities (see Fig. 1 & Table 1). In addition, the developed nano-carbon foam shows good carbon capture and storage performance (see Fig. 2 & Table 2).

Performance

Table 1. Supercapacitor Performance Summary

Capacitance (F/g)	Potential window (V)	Gravimetric Energy density (Wh/Kg)	Gravimetric Max. Power density (W/kg)	Volumetric Energy density (Wh/L)	Vol. Max Power density (W/L)
251	4	138.45	1.98×10^6	111.2	1.41×10^6

Table 2: CO_2 storage performance

Surface area (m^2/g)	CO_2 storage per unit amount of absorbents (milli-mol/g)
1139	23 @ 65 bar

Value Proposition

- Nano-carbon foam supercapacitor electrode without additives or binders delivering superior energy density (30 Wh kg^{-1}) and high power density (>10^5 W kg^{-1})
- Nano-carbon foam is also used for carbon capture and storage (23 milli-mol CO_2/g at 65 bar). Simple and fast single-step fabrication process without chemical reagents (i.e. no conductive additives or binders)
- Fabrication process utilizes conventional equipment and raw materials

Application Areas

- Supercapacitor electrode
- Carbon capture and storage
- Water desalination

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