Development and Characterization of graphene modified Cellulose derived carbon aerogels with superior thermal insulation

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Abstract

Efficient high-temperature insulation is vital for reducing energy consumption in the production of the materials required for electrification, including silicon wafers, silicon carbide and carbon-metal current collectors[1]. Carbon aerogels are highly porous carbon 3D structures which were synthetized with the aim of producing a microstructure on the micron-scale which could scatter thermal radiation more efficiently than traditional fibre cloth insulators[2][3]. However, it is still challengeable to fabricate carbonaceous materials with outstanding thermal insulation property owing to the difficult in structural regulation. Herein, graphene-cellulose derived carbon aerogels were produced by the carbonisation of freeze dried cellulose gels and graphene oxide was used as additive to modify their structure. The cellulose precursor also enhanced GO layer interaction and produced stable microstructure[4].

By controlling the synthesis conditions, the dimensions of the interstitial space were reduced from ~100 to ~10 microns, as measured by electron microscopy and X-ray computed tomography, and a porosity of up to 98% was achieved. The structure and thermal conductivity of the fabricated aerogels were investigated and their performance as high-temperature nsulators was evaluated. The thermal conductivity of carbon aerogel was to 0.23W/ (m·K) for 1773 K in argon atmosphere, compared to half for the larger pore aerogel and quarter for commercial fabrics.

References

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Figures

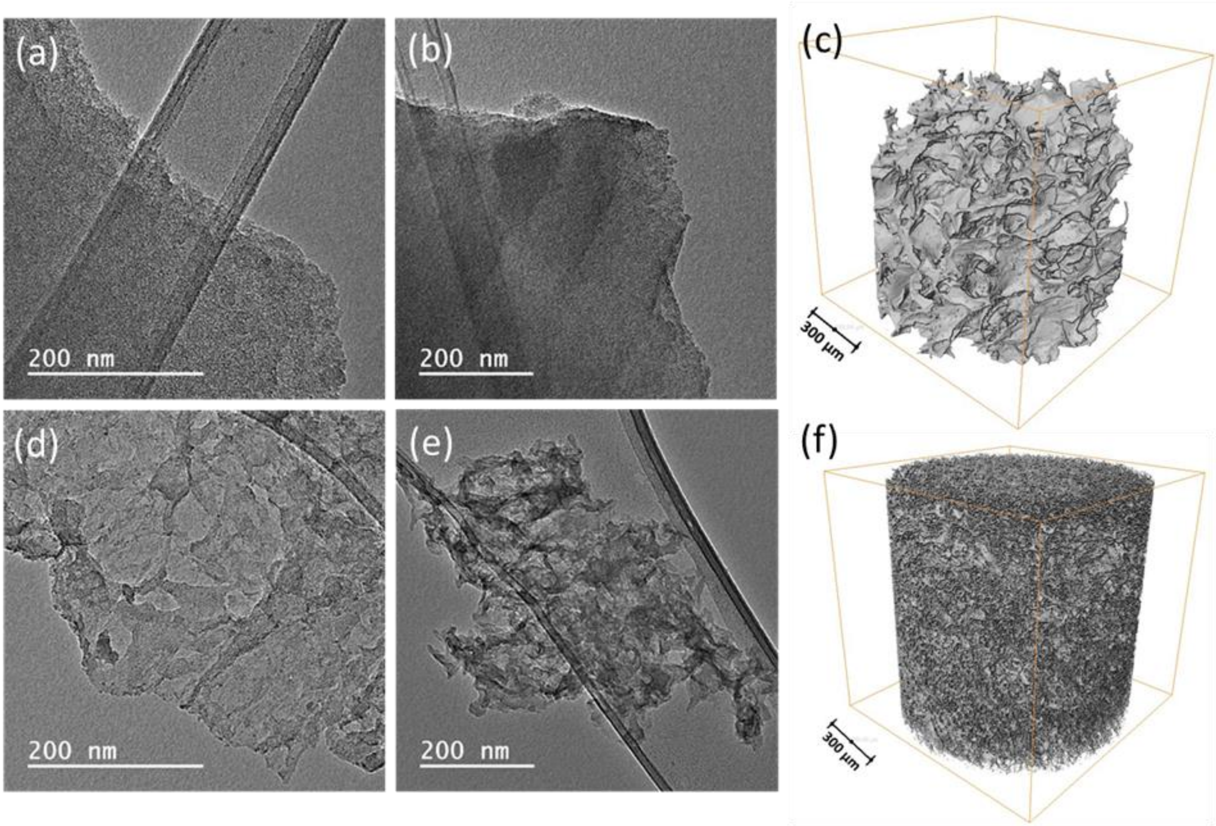

Figure 1: Transmission electron microscopy images of (a)-(b)MCC CA and (d)-(e) MCC+1GO CA; Micro-CT images of (a) MCC CA;(b) MCC+1GO CA

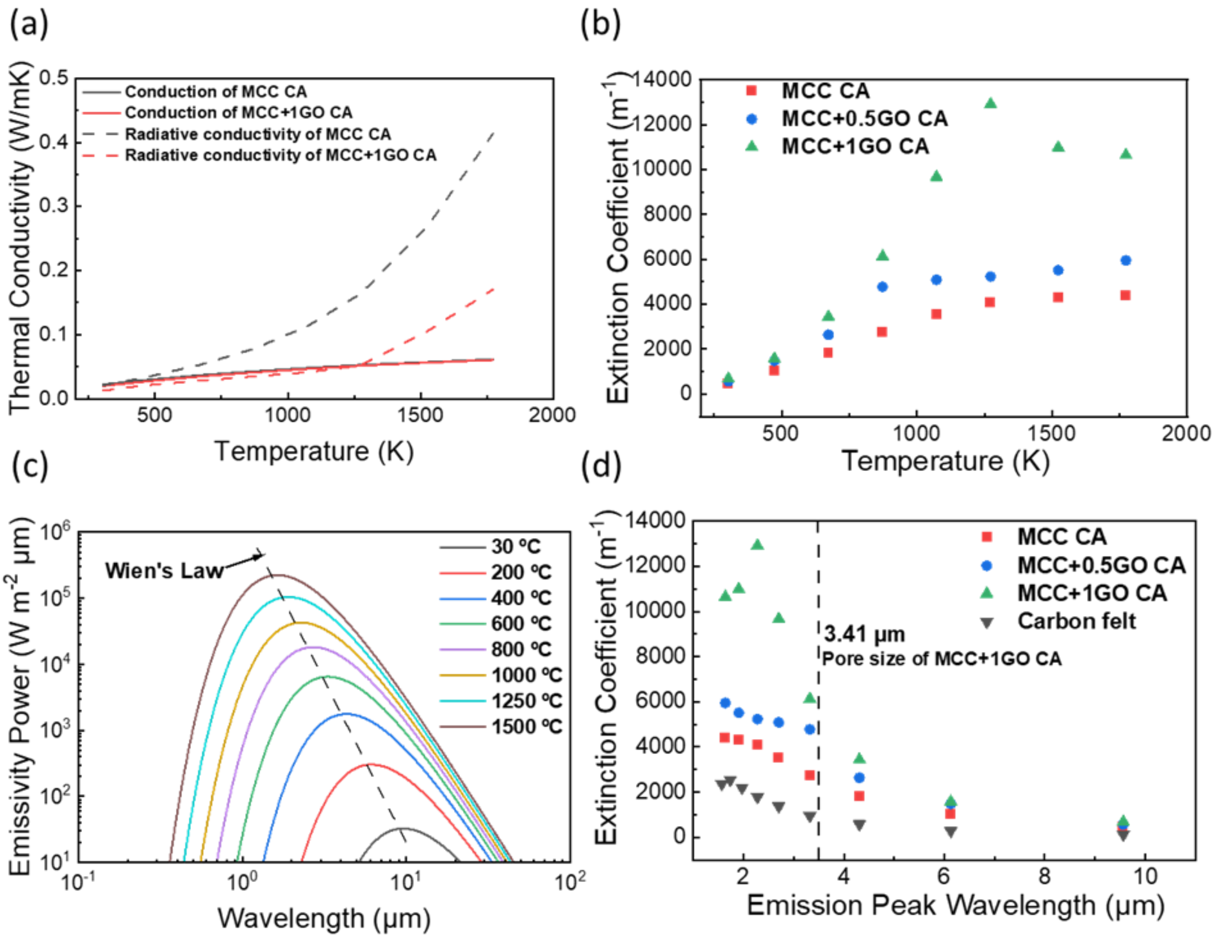

Figure 2 (a) Plot of calculated apparent thermal conductivities and heat transfer mechanisms versus temperatures for two carbon aerogels (b) Rosseland coefficient (β_R) as a funtion of temperature for carbon aerogels (c) Emissivity power as a function of wavelength and temperature (d) Plot of calculated extinction coefficient versus emission peak wavelength under different temperature