AUTEX 2022
21st World Textile Conference

Resistive heating performance of waste cotton-derived carbon obtained by salt-assisted hydrothermal carbonization

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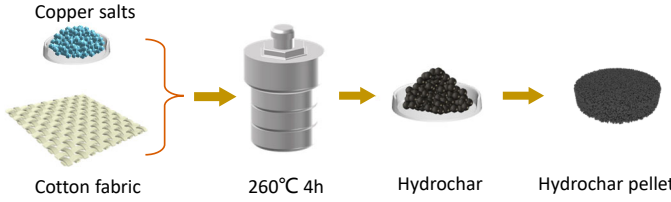
Introduction

Hydrothermal carbonization (HTC) is one of the effective technologies for the conversion of cotton textile into carbon materials. Various additives, including $AlCl_3$, $CaCl_2$, LiCl, $MgCl_2$, have also been used to further improve the hydrolysis efficiency of cellulose in the HTC process. In this work, copper-doped hydrochar was obtained by adding copper salts to the HTC process and the resistive heating behaviour of the resulting hydrochar was investigated.

Experimental

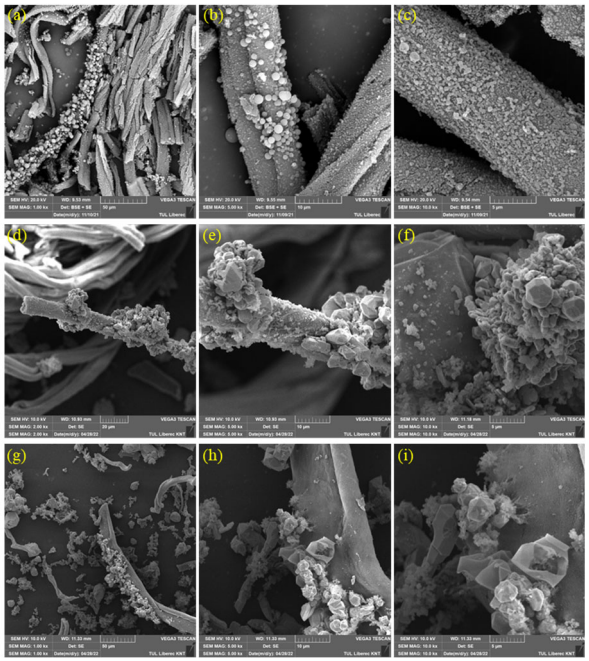
The copper-doped hydrochar was prepared via hydrothermal carbonization. Typically, 1 g of cotton fabric was cut into small pieces and mixed with 10 g of copper salt and deionized water. The mixture was transferred into a 150 mL stainless steel Teflon lined autoclave. Then, the autoclave was heated in an oven to the target temperature of 260 °C at a heating rate of 10 °C min^{-1} for 4h. After cooling to room temperature, the solid product (hydrochar) was filtered out and rinsed repeatedly with water. Later, the hydrochar was dried in oven at 65 °C for further characterization. The hydrochars were labeled as CO_x, where x was the type of metal salt used. Especially, the hydrochar obtained with only cotton and water was marked as CO.



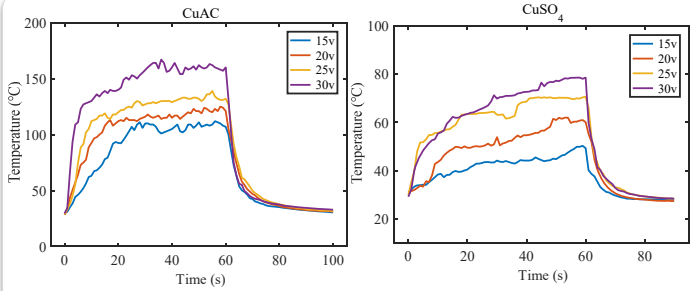
Acknowledgment

This work was supported by the student grant competition SGS-2022-6031at Technical University of Liberec. The authors also acknowledge the project 'Advanced structures for thermal insulation in extreme conditions' (Reg. No. 21–32510 M) granted by the Czech Science Foundation (GACR).

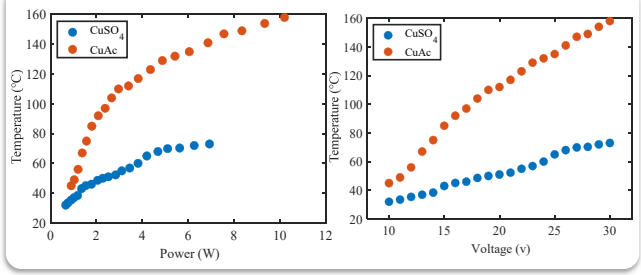
Morphology



Heating performance



Heating efficiency



Characteristic parameters

	Voltage(v)	τ_g(s)	τ_d(s)
CO_CuSO_4	15	18.6±5.5	44.5±26.1
	20	20.7±6.2	31.7±20.9
	25	8.9±2.5	31.5±15.4
	30	12.5±2.5	28.7±13.5
CO_CuAc	15	19.4±3.4	37.1±13.8
	20	10.5±2.6	38.4±17.8
	25	10.7±4.2	38.9±17
	30	8.1±3.7	31.9±5.7

Conclusion

In this work, copper salt-assisted HTC was employed to prepare cotton waste-derived hydrochar. Both copper-doped hydrochar exhibited electro-thermal conversion behaviour under applied voltages. In addition, characteristics parameters were calculated by fitting data from the heating and cooling section. A relevance between temperature and the corresponding required electrical power was established. The result indicated that CuAc-assisted hydrochar had better electrical energy efficiency in reaching higher maximum temperatures. By examining the resistive heating properties of hydrochar, this work expands an application for HTC products.

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