Solid-state supercapacitors based on screen-printed conductive textiles

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Background

Conductive textiles (CTs), owing to their light weight, flexibility, permeability, and wearing comfort, have emerged as promising building blocks to design a wide variety of stretchable devices, including sensors, actuators, and energy harvesting and storage devices. With this latter aim in mind, this work presents the electrochemical properties of electrodes produced from two textile substrates (*woven and knitted 100% cotton fabrics*) for their use as solid-state supercapacitors (SCs).

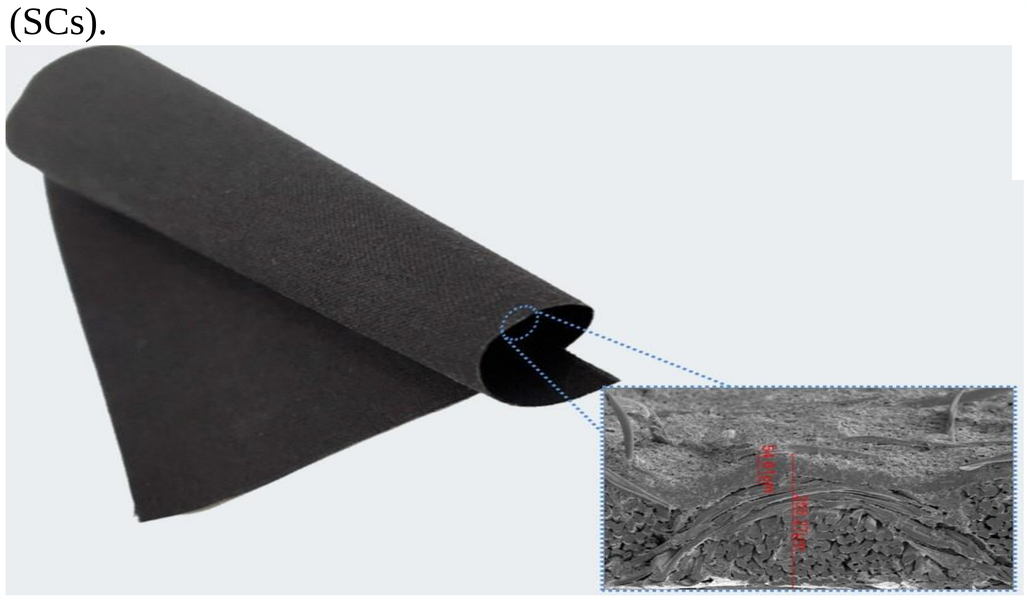

Fig. 1 Screen-printed conductive textiles (CTs).

Experimental

First, the textiles were functionalised with a polyurethane (PU)/graphene nanoplatelets (GNPs) based paste through screen-printing with the aim of obtaining CTs **(Fig. 1)**. On these CTs, further layers of activated carbon (AC) and manganese oxide (MnO_2), have been deposited to obtain negative/positive electrodes, which were then assembled as SCs with an Na^+-form Aquivion®E87-05S electrolyte membrane **(Fig. 2)**, and evaluated by cyclic voltammetry (CV), galvanostatic charge/discharge (G–CD), and electrochemical impedance spectroscopy (EIS) (**Fig. 3**).

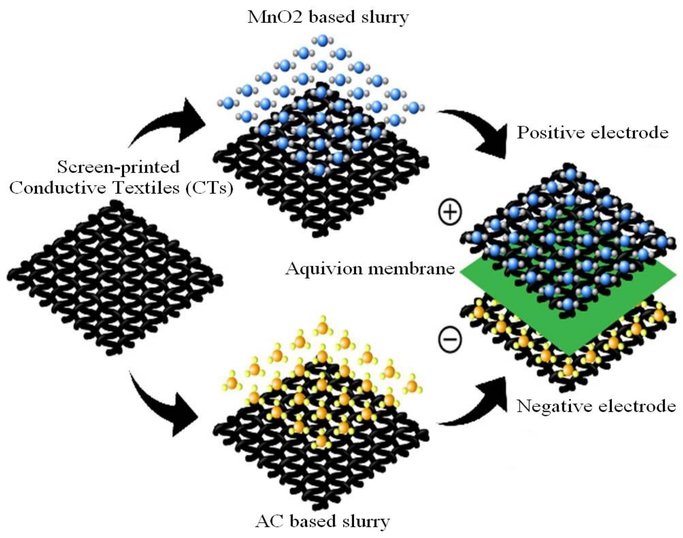

Fig. 2 Asymmetric SC produced from screen-printed CTs.

Results

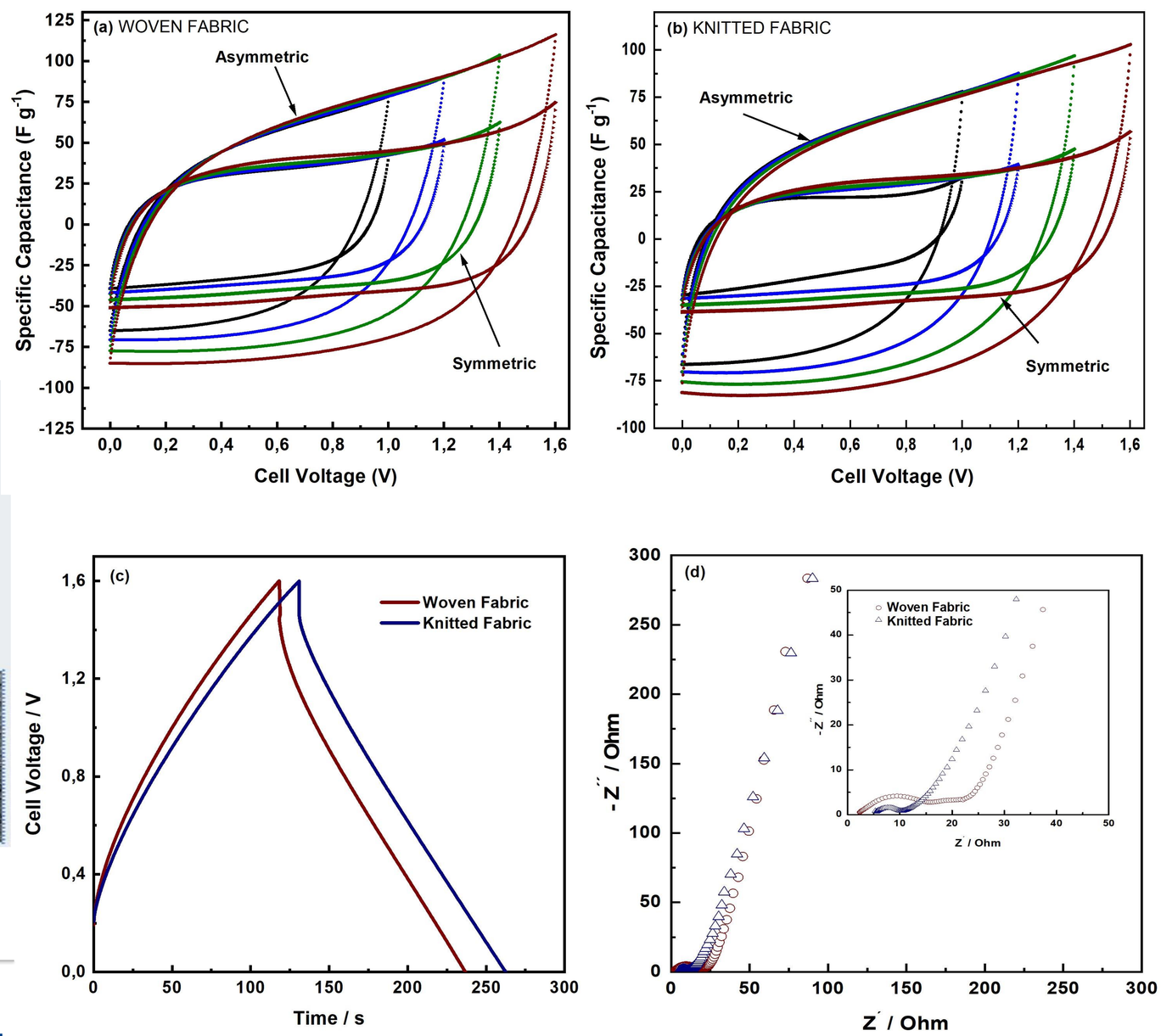

Fig. 3 (**a,b**) comparison of voltammograms of symmetric (electrodes with AC) and asymmetric SCs at 10 mVs^{-1} (**c**) G-CD at 0.2 A g^{-1} and (**d**) Nyquist plots from impedance analysis of asymmetric SCs based on screen-printed CTs.

Conclusions

- ✓ Flexible electrodes with multi-layer structure are successful produced by screen-printed method.
- ✓ Flexible supercapacitors have been assembled with Na^+-form Aquivion®E87-05S electrolyte membrane and tested in solid-state configurations.
- ✓ The electrochemical performance of both flexible devices (with woven and knitted fabric) varied from 60 to 80 Fg^{-1} (for single electrode), with higher performance achieved by asymmetrical supercapacitor devices. Moreover, they are capable of working in voltage window from 0 to 1.6 V in a neutral aqueous environment.
- ✓ It is found that the high resistance to charge transfer, R_{ct}, is the main obstacle to obtaining higher specific capacitances and energy densities.

Acknowledgments

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References

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