廢輪胎回收活性碳應用於超級電容器

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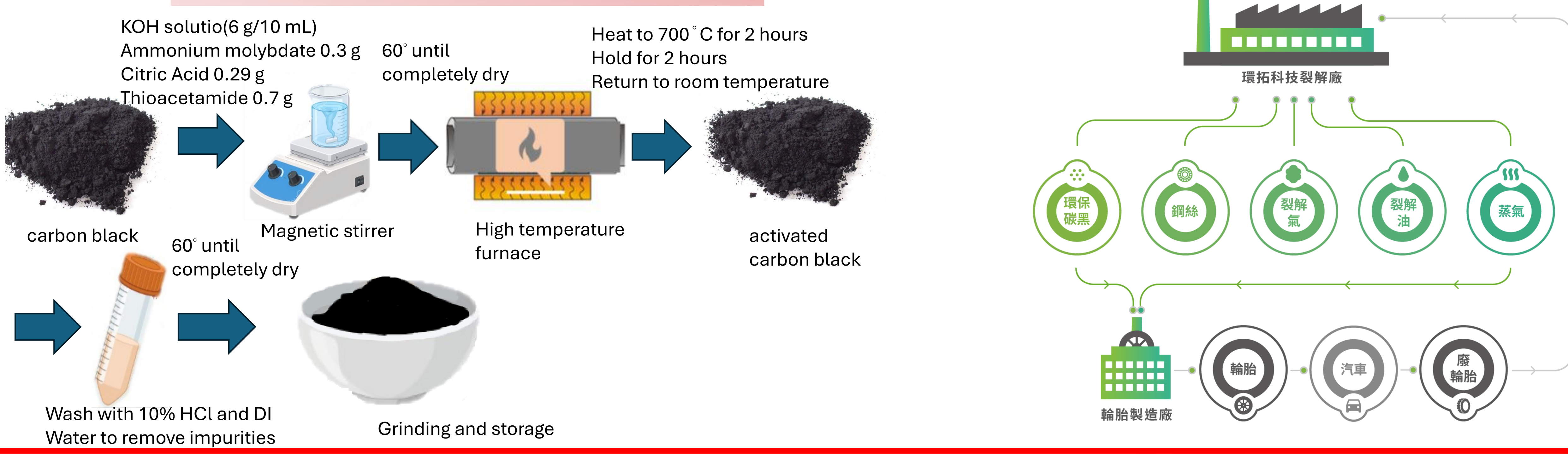
Abstract

Over 330 million waste tires are generated globally each year. Due to their complex composition and non-biodegradable nature, improper disposal poses a serious threat to the environment. Consequently, how to efficiently recycle waste tires and transform them into high-value products has become a critical issue in environmental protection and circular sustainability. In this report, we collaborated with ENRESTEC Inc., which utilized an innovative pyrolysis technology to convert waste tires into environmentally friendly carbon black. Subsequently, we simultaneously activated and modified the carbon black with molybdenum sulfide (MoS_2) through a thermal treatment for supercapacitor application. With various materials characterization techniques, we evaluated its microstructure, specific surface area, and electrochemical properties. The proposed novel activated carbon shows high specific surface area and enhanced electrochemical properties, which facilitates its application in energy storage devices. This work not only demonstrates a practical approach for waste tires recycling and reduction of environmental pollutants but also highlights the potential for energy storage materials application, offering innovative strategy for green technology and sustainable management for waste tires.

Experimental

WTPC with added KOH becomes AWTPC, and WTPC with added KOH, ammonium molybdate, citric acid, and thioacetamide becomes AWTPC-MoS



Results and discussion

(A)

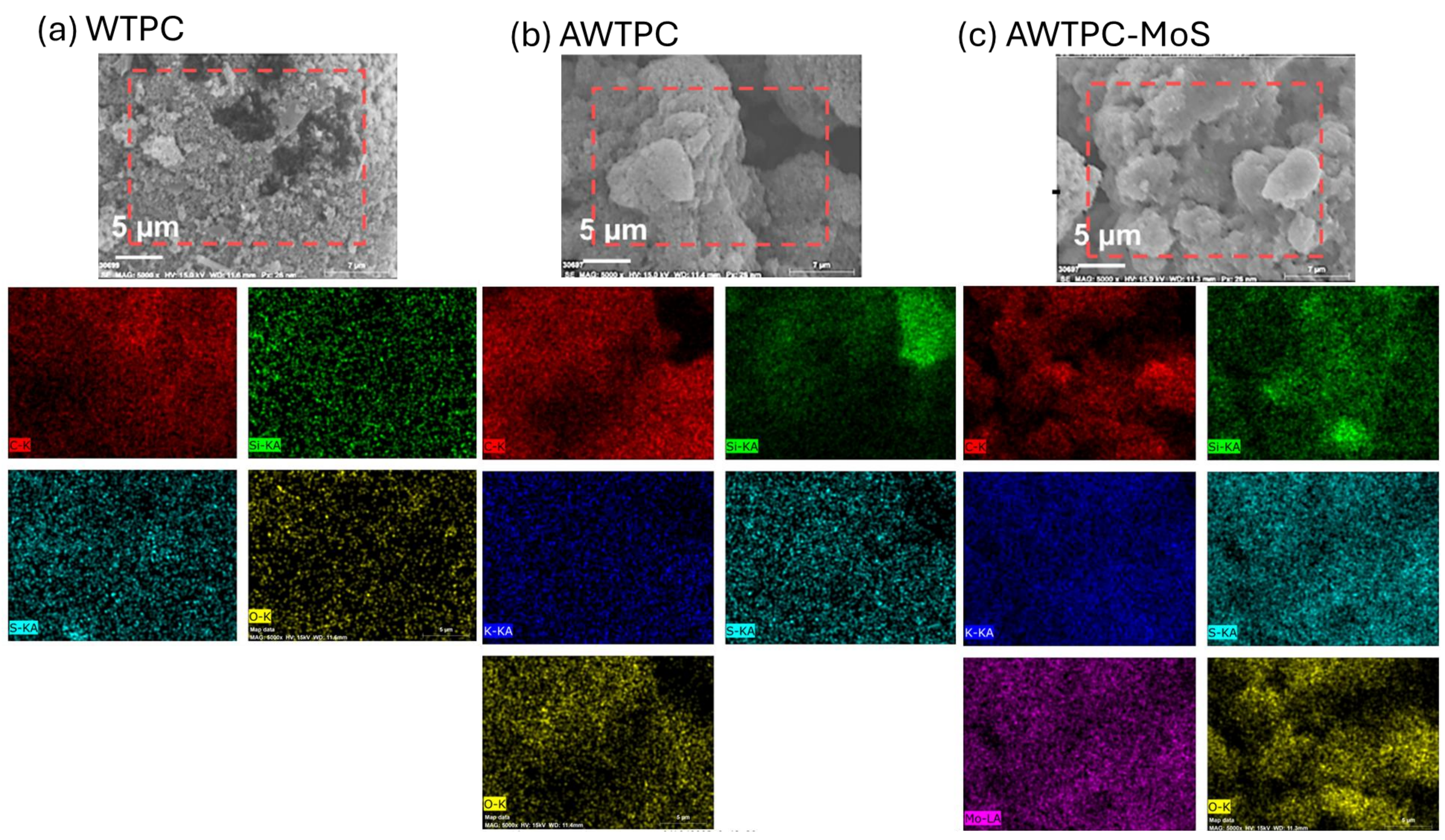


Figure A . SEM surface morphology analysis and EDS element distribution maps. (a) WTPC, (b) AWTPC, (c) AWTPC-MoS.

(B)

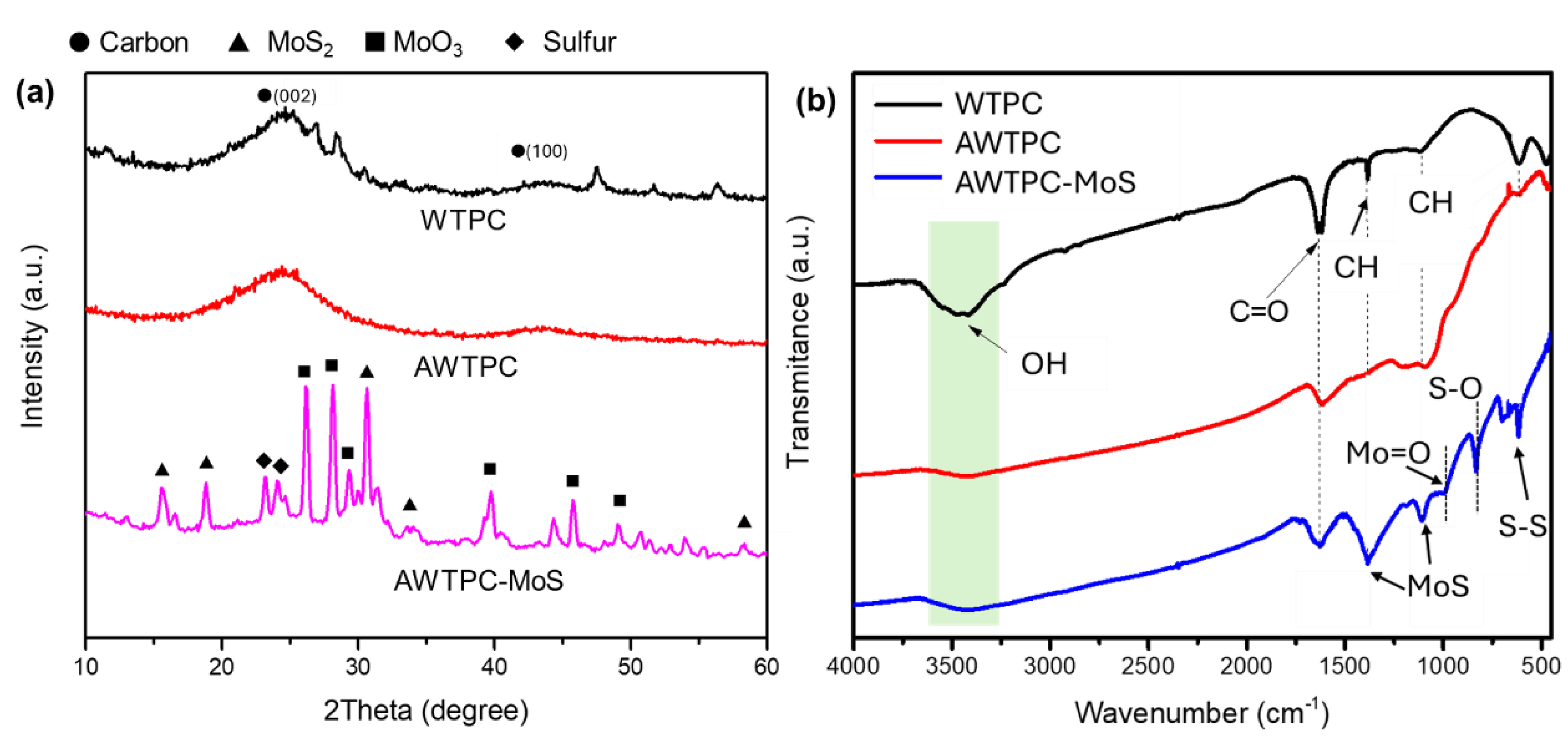


Figure B . (a) XRD and (b) FTIR analysis results of the materials.

(C)

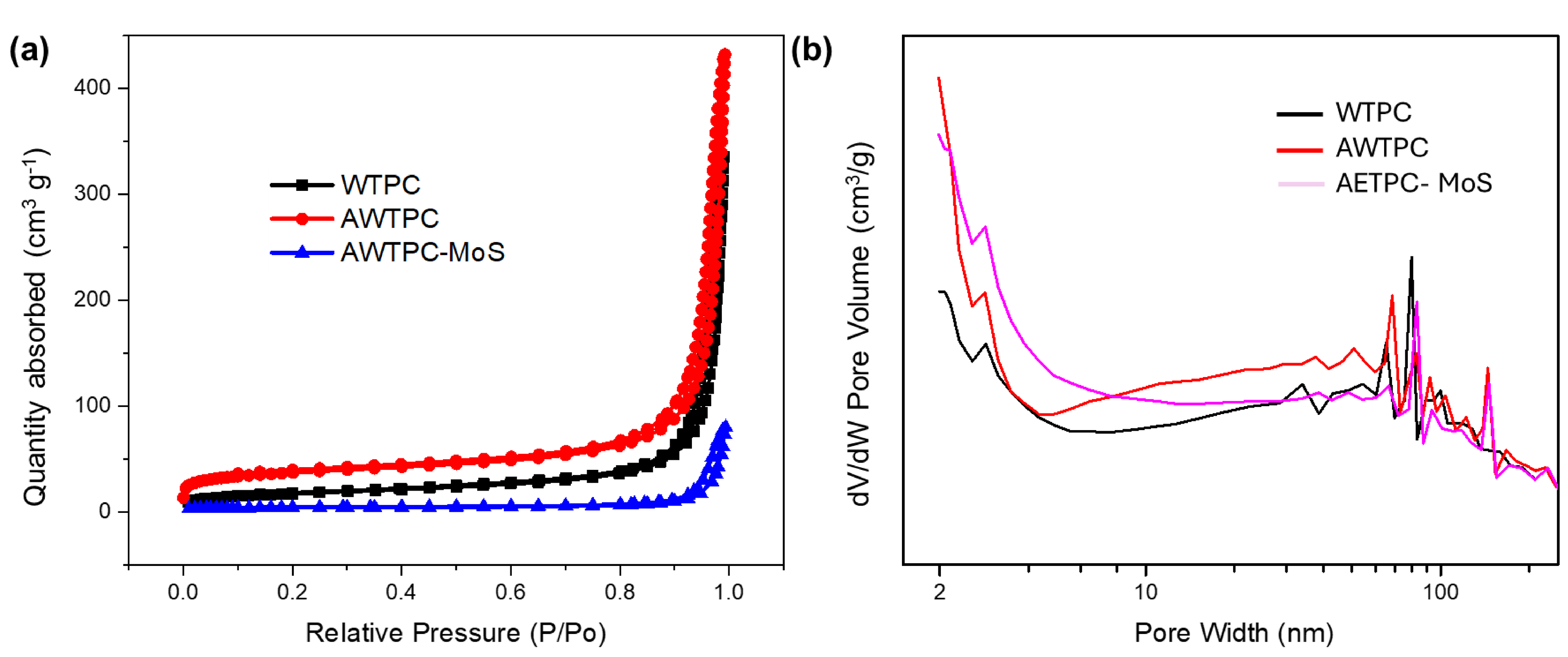


Figure C . Nitrogen adsorption/desorption curves of the material, as well as pore distribution information.

(D)

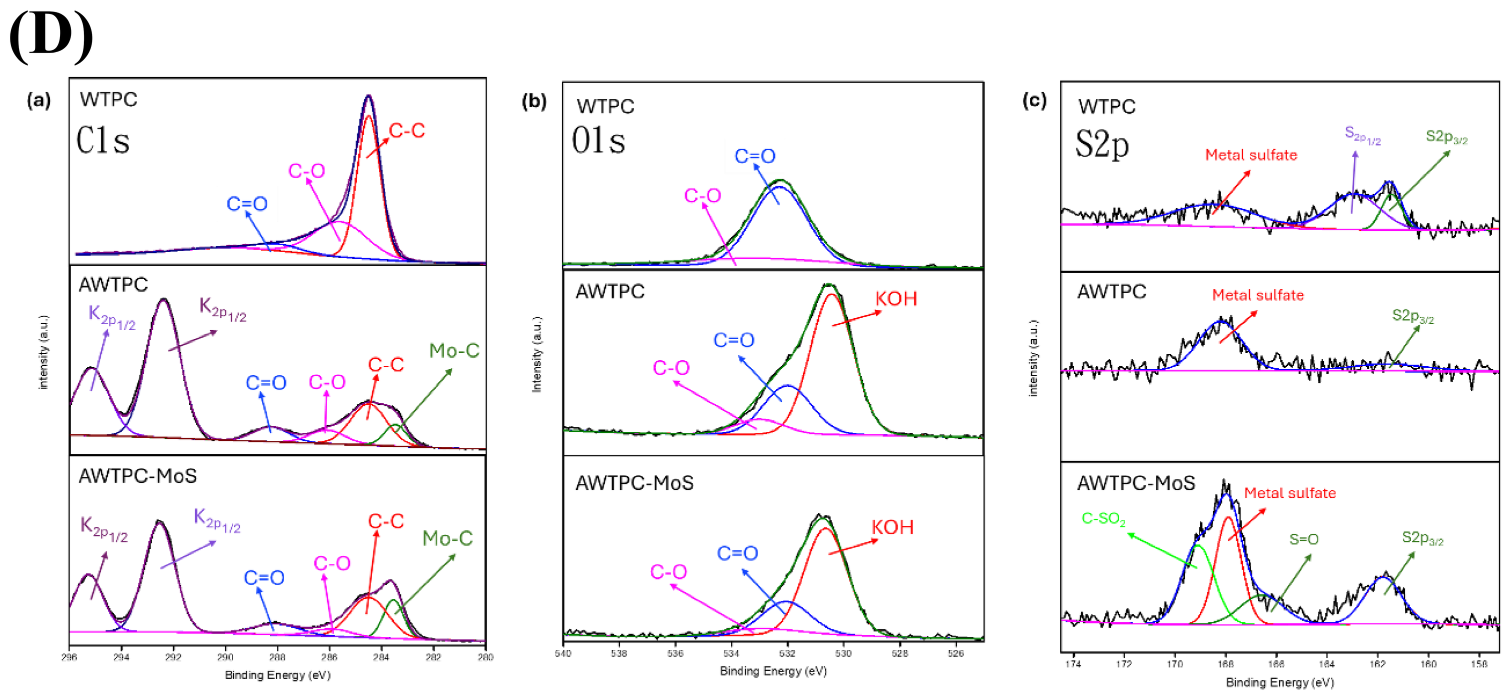


Figure B . XPS curve of the material and element link distribution information.

(E)

Figure E . Electrode plates for electrochemistry

(F)

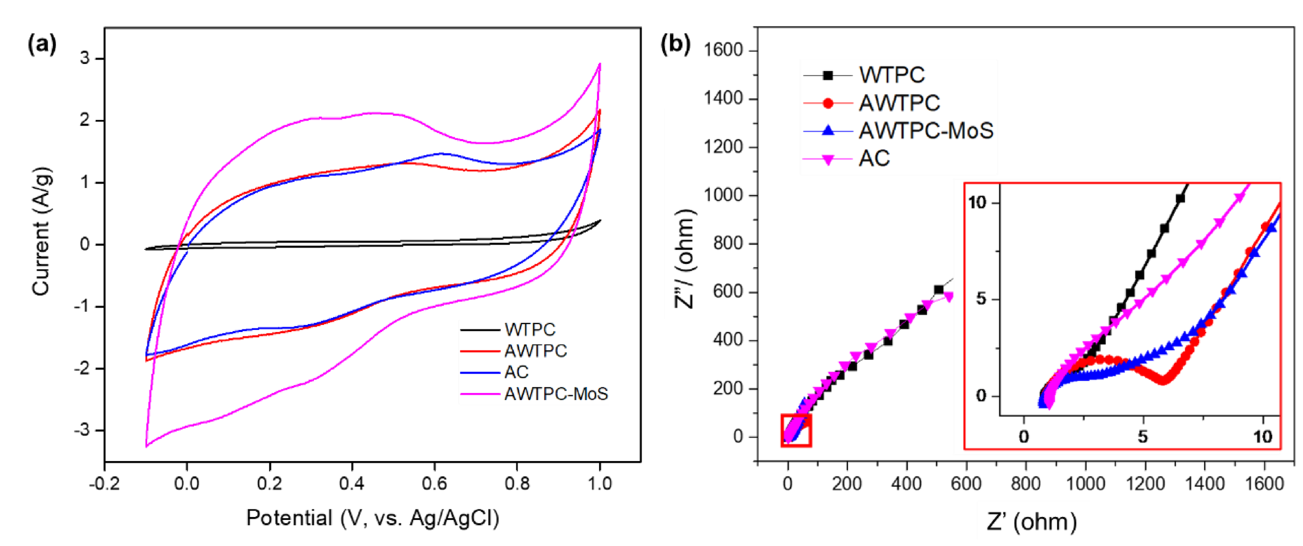


Figure F . (a) CV and (b) EIS analysis results of the electrode materials prepared in this study.

(G)

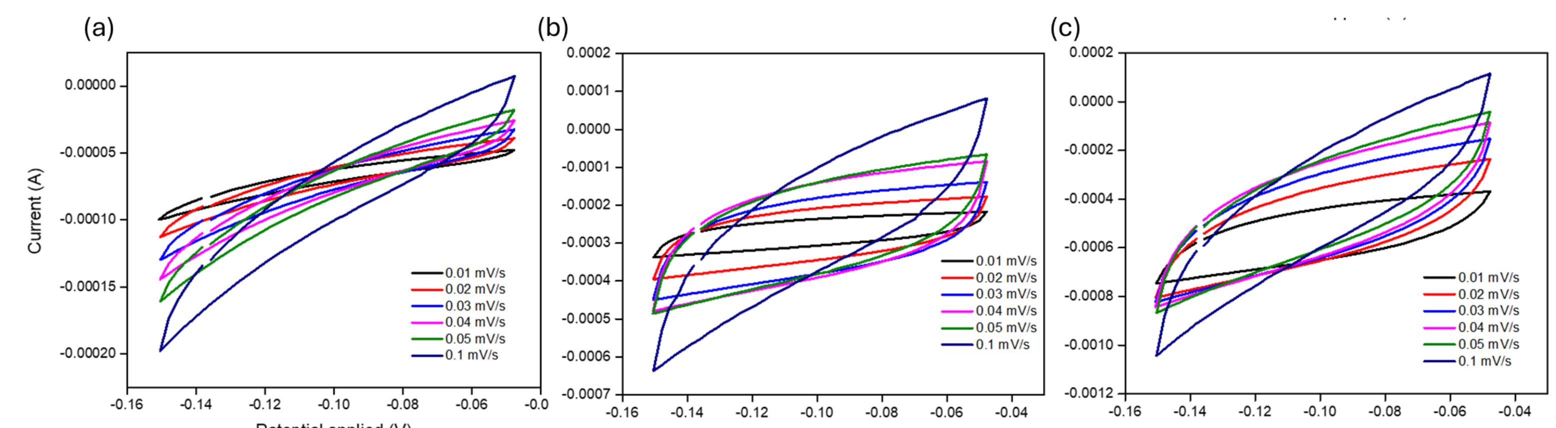


Figure G . ECSA diagrams of electrode materials prepared in this study: (a) WTPC, (b) AWTPC, (c) AWTPC-MoS.

Conclusion

This study uses waste tire pyrolytic carbon (WTPC) as an electrode substrate. After activation and Mo/S modification, the material (AWTPC) gains higher conductivity, porosity, and electrochemical performance. KOH etching increases pores, while Mo and S form Mo oxides and MoS_2, improving charge storage. This provides a simple recycling route for high-performance energy materials.