

Laboratorio di Elettrochimica
dei Materiali per l'Energetica

"Green supercapacitors for energy and environmental sustainability"

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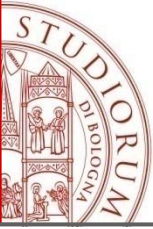
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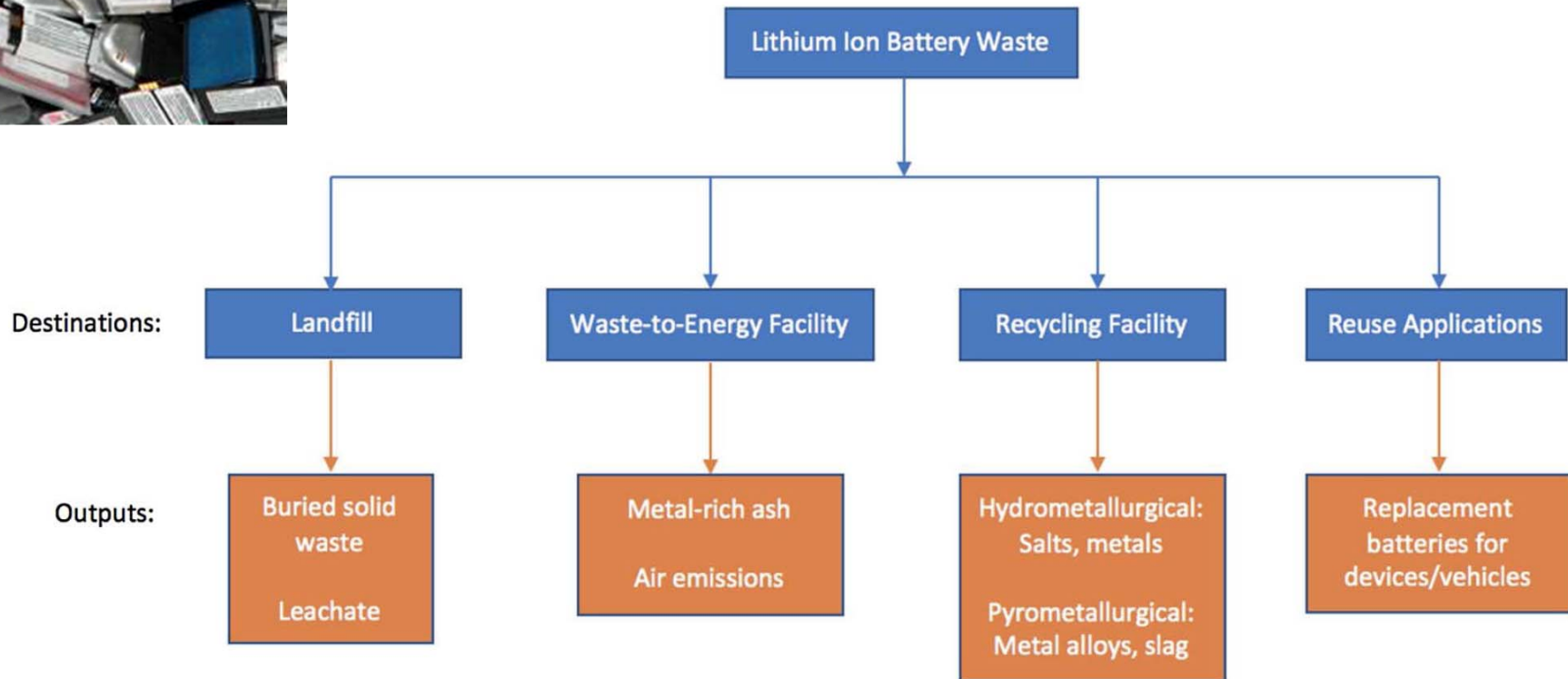




Waste management of end-of-life systems

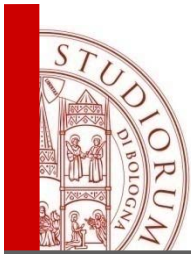


This increased need for batteries and supercapacitors will mean large end-of-life waste



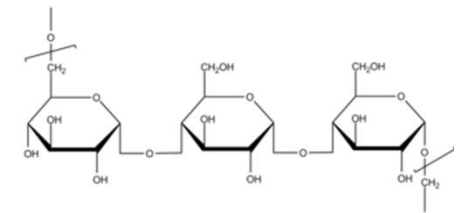
Green components and processes are required for low environmental and cost end-of-life supercapacitor management

K.M. Winslow et al. Resources, Conservation & Recycling 129 (2018) 263–277



Green Supercapacitor @LEME

Pullulan Based EDLC



Conventional EDLC

Separator

PTFE/PP

Electrolyte

ACN/ NEt_4BF_4

Binder

PTFE/PVDF

Active Material

Activated Carbon

Pullulan based EDLC

Separator

Pullulan electro-spun membrane

Electrolyte

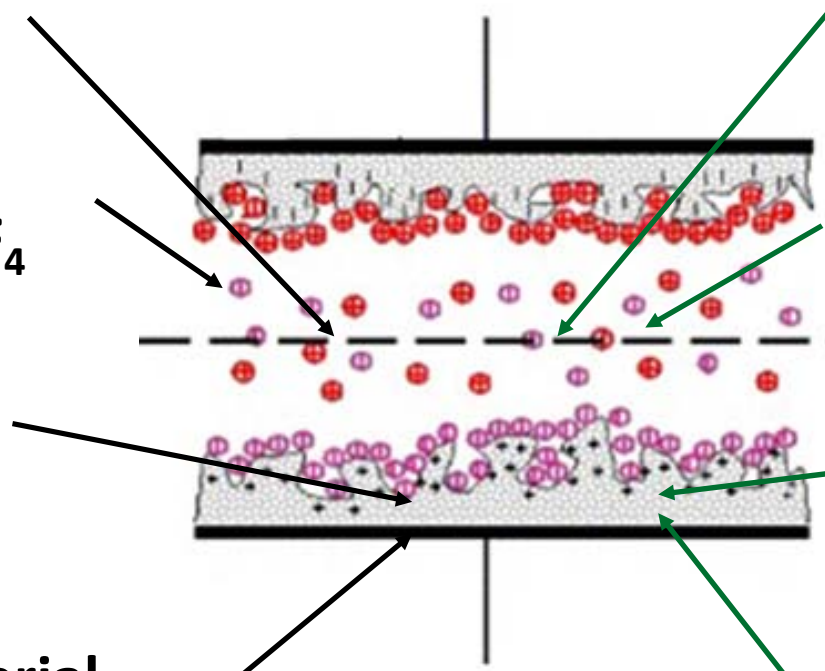
EmimTFSI ionic liquid

Binder

Pullulan based aqueous binder

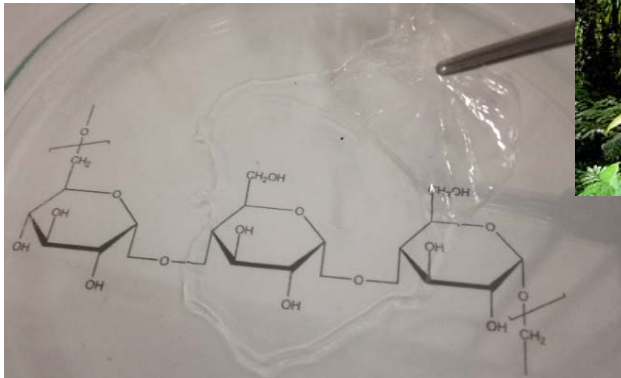
Active material

Carbon from biomass (pepper seed)



Pullulan-based EDLC

**Pullulan good
filming properties**



Epiphyte

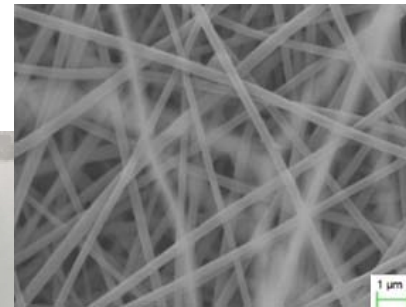
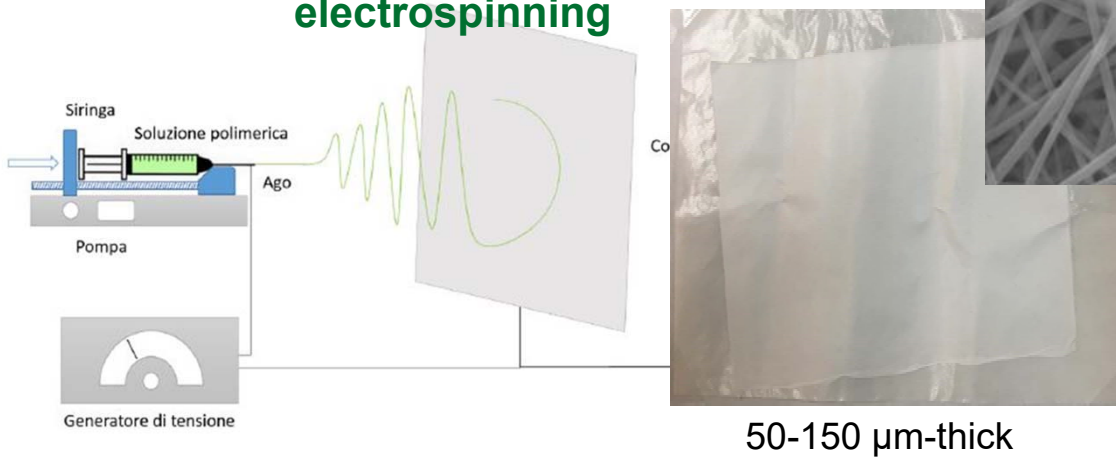


*Aureobasidium pullulan
fungus*



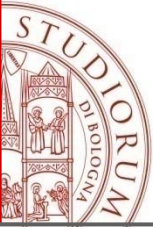
➔ **Binder**

**Pullulan mats processable by
electrospinning**



➔ **Separator**





Pullulan-based EDLC



Activated carbon electrode from biological waste (biochar)

PP-AC: carbon derived from

The pyrolysis of Bell peppers seeds at 850 °C with KHCO_3 activating agent

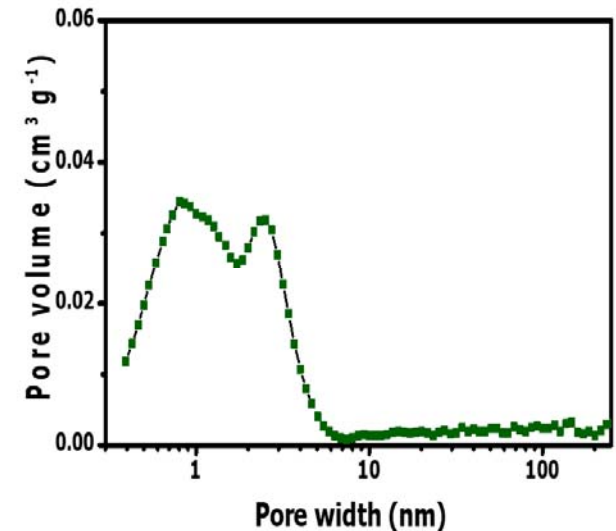
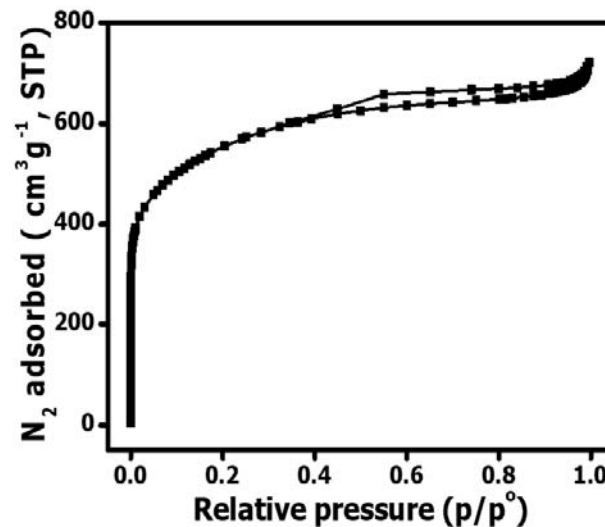


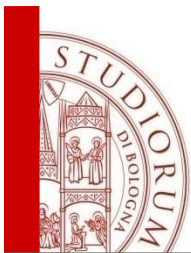
Electrode composition

70% AC/ 10 % CC and 20 % Binder

Mass loading

We 3.82 mg / 6 mg cm^{-2} & Ce 3.53 mg / 5.55 mg cm^{-2}



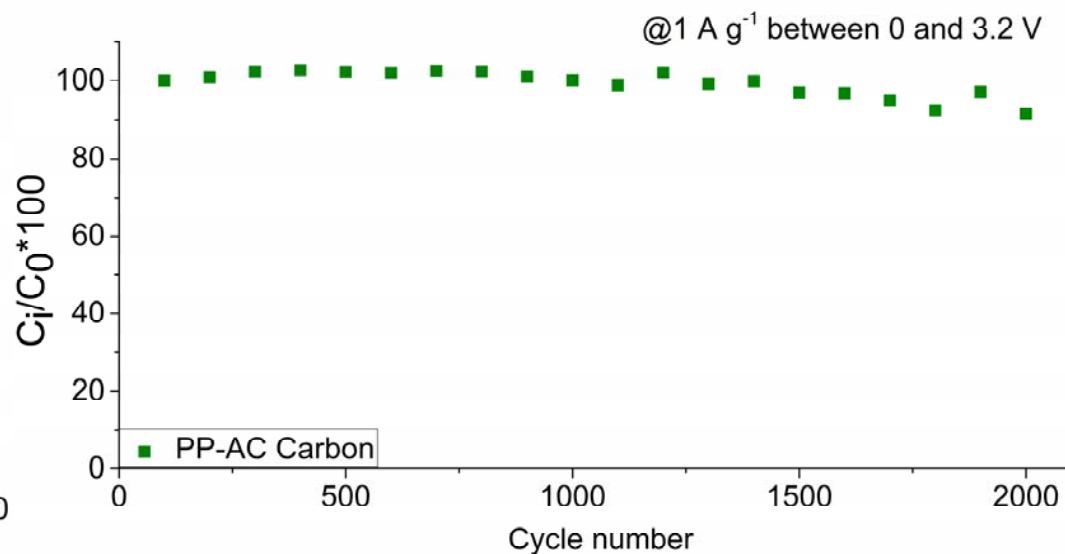
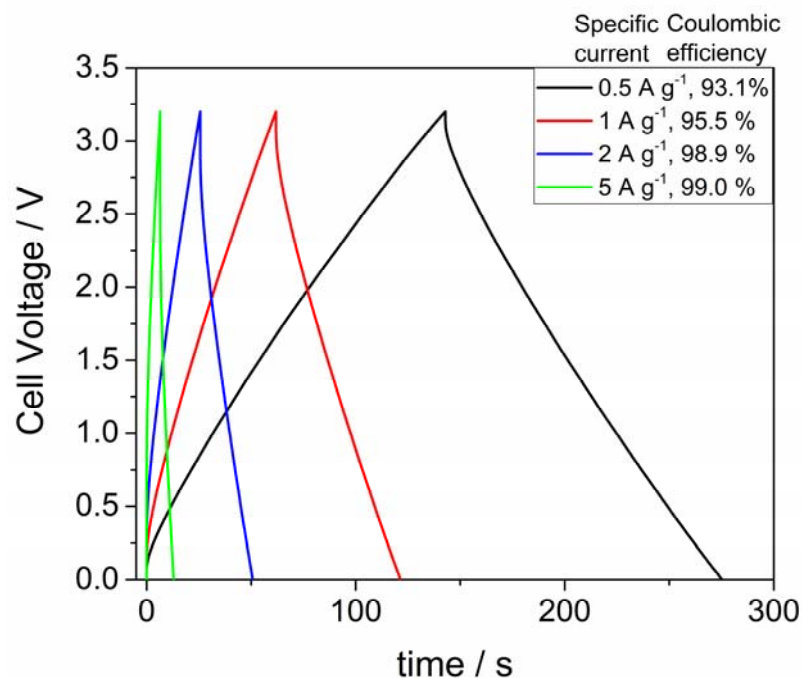


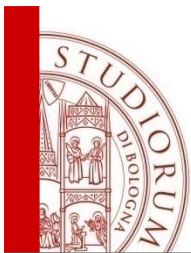
Pullulan-based EDLC

PP-AC electrodes & EMIMTFSI electrolyte

Carbon	Code	S_{BET} m^2g^{-1}	$V_{>0.4 \text{ nm}}$ cm^3g^{-1}	C_{carbon} Fg^{-1}	I_D/I_G	E Wh/kg	P kW/kg
Pepper- biochar	PP-AC	1990	0.94	115	0.96	28	7

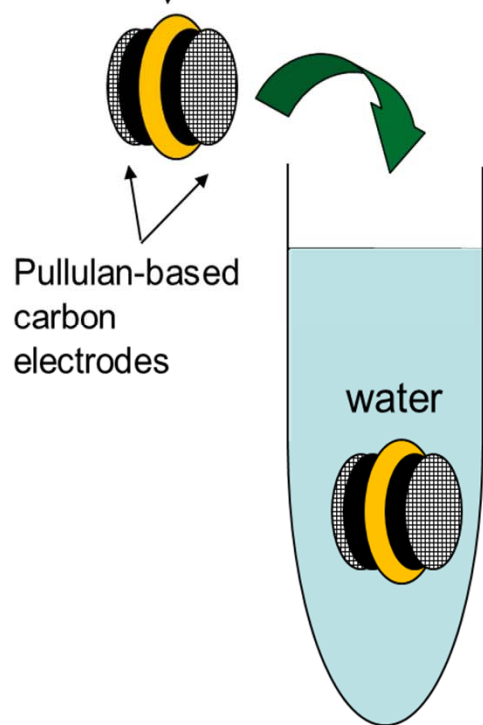
Charge/discharge galvanostatic cycle



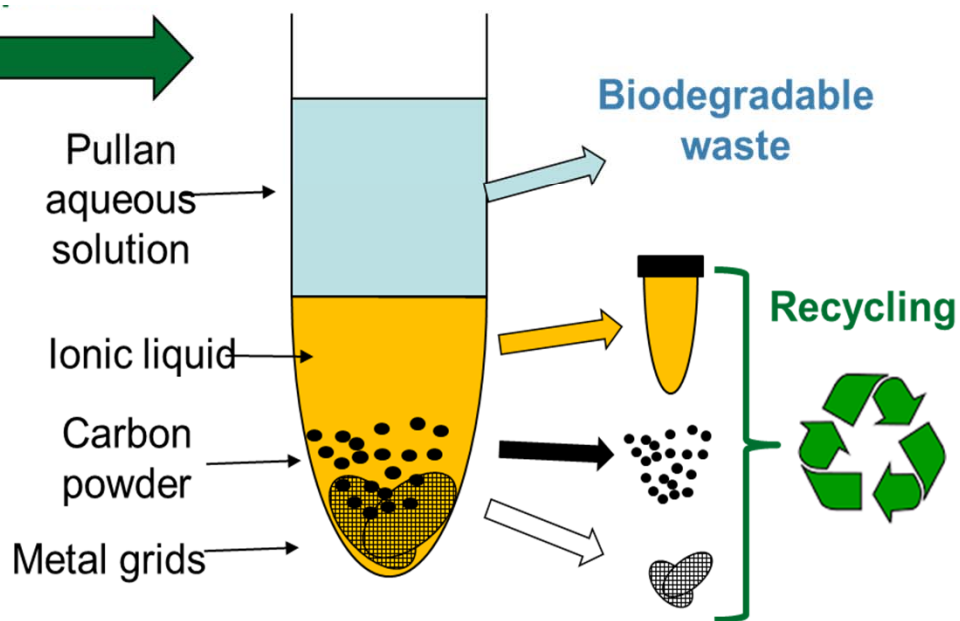


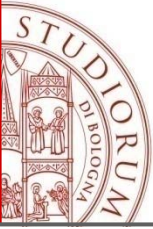
Pullulan-SC end-of-life management

Pullulan-separator soaked with hydrophobic ionic liquid (IL)



EDLC component separation





ACKNOWLEDGMENTS

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FARNESINA



MINISTERO DELL'AMBIENTE
DELLA TUTELA DEL TERRITORIO E DEL MARE

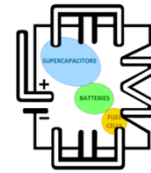


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