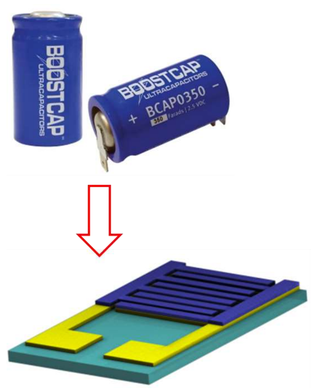
Marker Pen Lithography for On-Chip Energy Storage

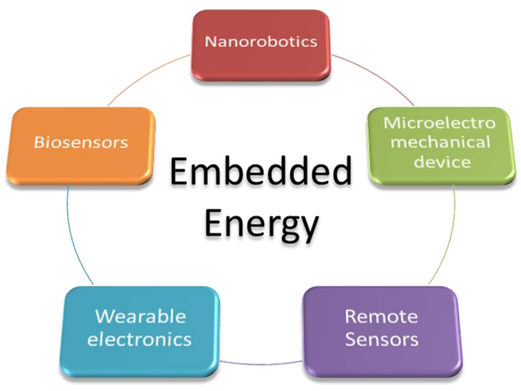
Qiu Jiang†
† King Abdullah University of Science and Technology

INTRODUCTION

Miniaturization and emerging applications of electronics has created a need for both on-chip energy harvesting and storage components

- Self-powered & remote sensing networks
- Implantable sensors (pacemakers,1 µW)
- MEMs & portable electronic systems (RFID tags,1-100 µW)





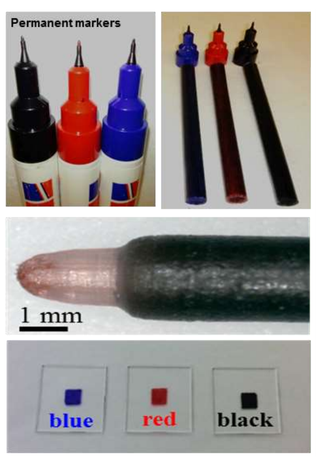
WHY MICROSUPERCAPACITOR

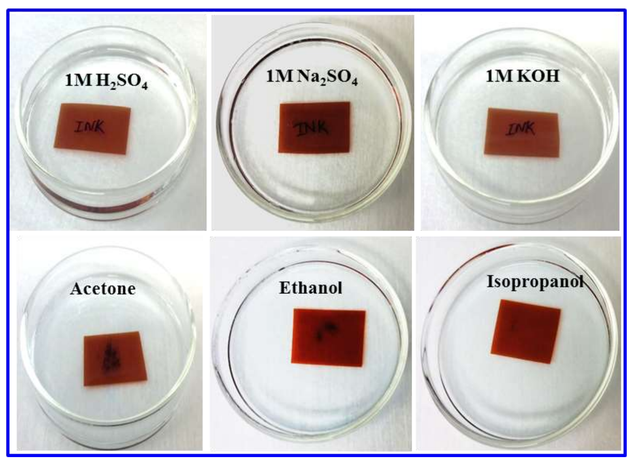
Thin film Battery
- Low power density
- Low cycle life

Micro-supercapacitor (MSC) offers:
- High power density
- Long cycle life
- Maintenance-free

MOTIVATION (SOLUBILITY CONTRAST)

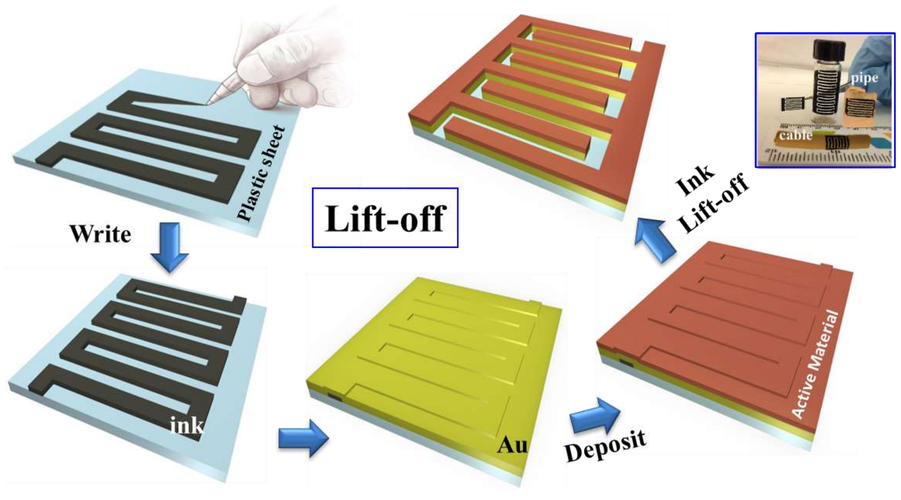
The ink of the permanent marker includes fast drying and less toxic solvents such as alcohols, which play the role of liquid carrier to dissolve and transport ink colorant and resins through the fi brous sponge. Ink resin is typically a glue-like polymer such as polyamide, acrylic, rosin, or phenolic which improves adhesion of the colorant pigment to surfaces after solvent evaporation





- permanent ink patterns were unaffected by aqueous media p
- ermanent ink marker pattern can be erased by organic solvents such as acetone, ethanol, and isopropanol
- solubility contrast of the ink toward aqueous and organic media resembles that of photoresist at the stages of development

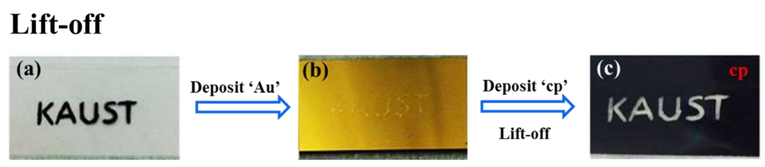
PROCESS FLOW SEQUENCE FOR FABRICATING MSC



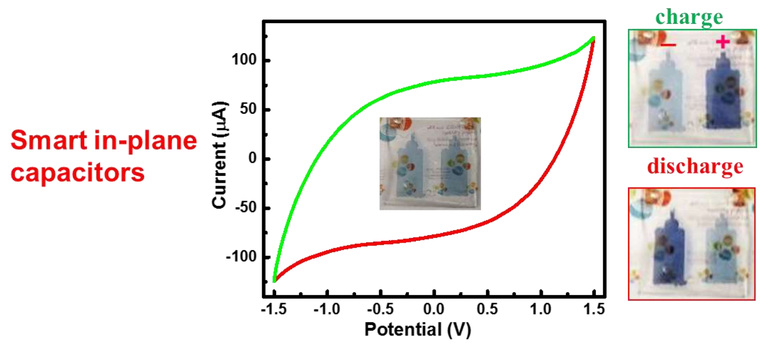
In principle, various active materials such as carbon, metal oxides/hydroxides can also be deposited by painting, sputtering, and electrochemical deposition

.

VERSATILITY OF THE METHOD



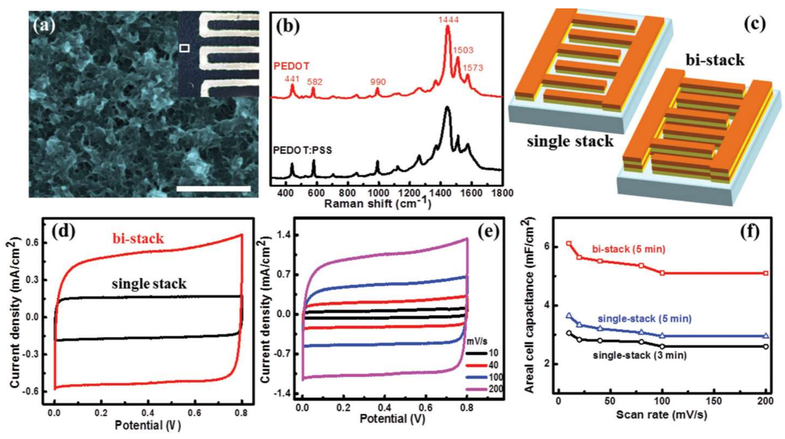
Transparent, electrochromic on-chip microsupercapacitors



This technique is quite simple yet versatile enough to fabricate planar, curvilinear, and electrochromic microsupercapacitors

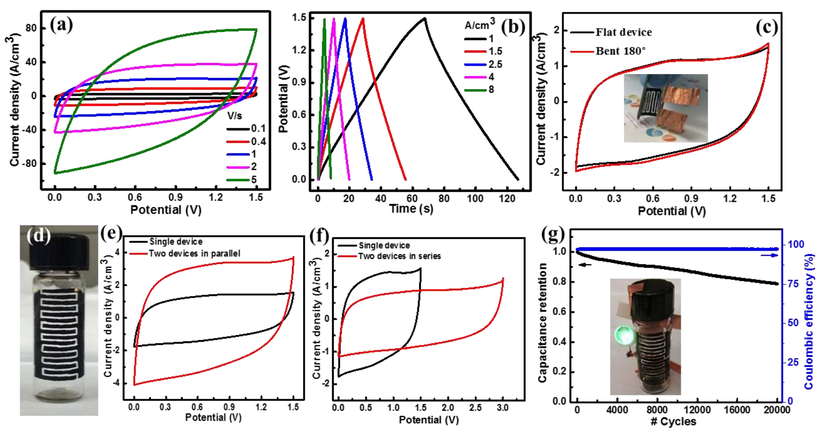
ELECTROCHMICAL PERFORMANCE

- The nanostructured porous PEDOT film can facilitate faster ionic transport resulting in improved electrochemical performance
- vertical stacks of conducting polymer/metal MSCs for improving the electrochemical performance



SOLID-STATE DEVICE AND STABILITY

- Higher electrochemical potential window (>1 V) is achieved by using leakage-free gel electrolytes
- This solid-state MSC exhibits good cycling stability with a capacitance retention up to 85% and coulombic efficiency of 95% over 20k cycles



CONCLUSION

- A simple and versatile strategy was demonstrated for fabricating on-chip energy storage devices employing sacrificial ink patterns.
- This technique was used to fabricate microsupercapacitors over a wide variety of substrates.
- We have successfully demonstrated both liftoff and etching schemes of this technique to realizing flexible, curved, and electrochromic microsupercapacitors.
- we have shown that it can be used to make vertical stacks of multilayer structures without using sophisticated optical aligning equipment

REFERENCES

[1] Jiang Q, Kurra N, Alshareef H N. Advanced Functional Materials, 2015, 25(31): 4976-4984.
[2] Jiang Q, Kurra N, Xia C, et al. Advanced Energy Materials, 2016.

Acknowledgements
King Abdullah University of Science and Technology: