

Nanomaterials and Scalable, Low-Cost Screen Printing for Soft Wearable Bioelectronics

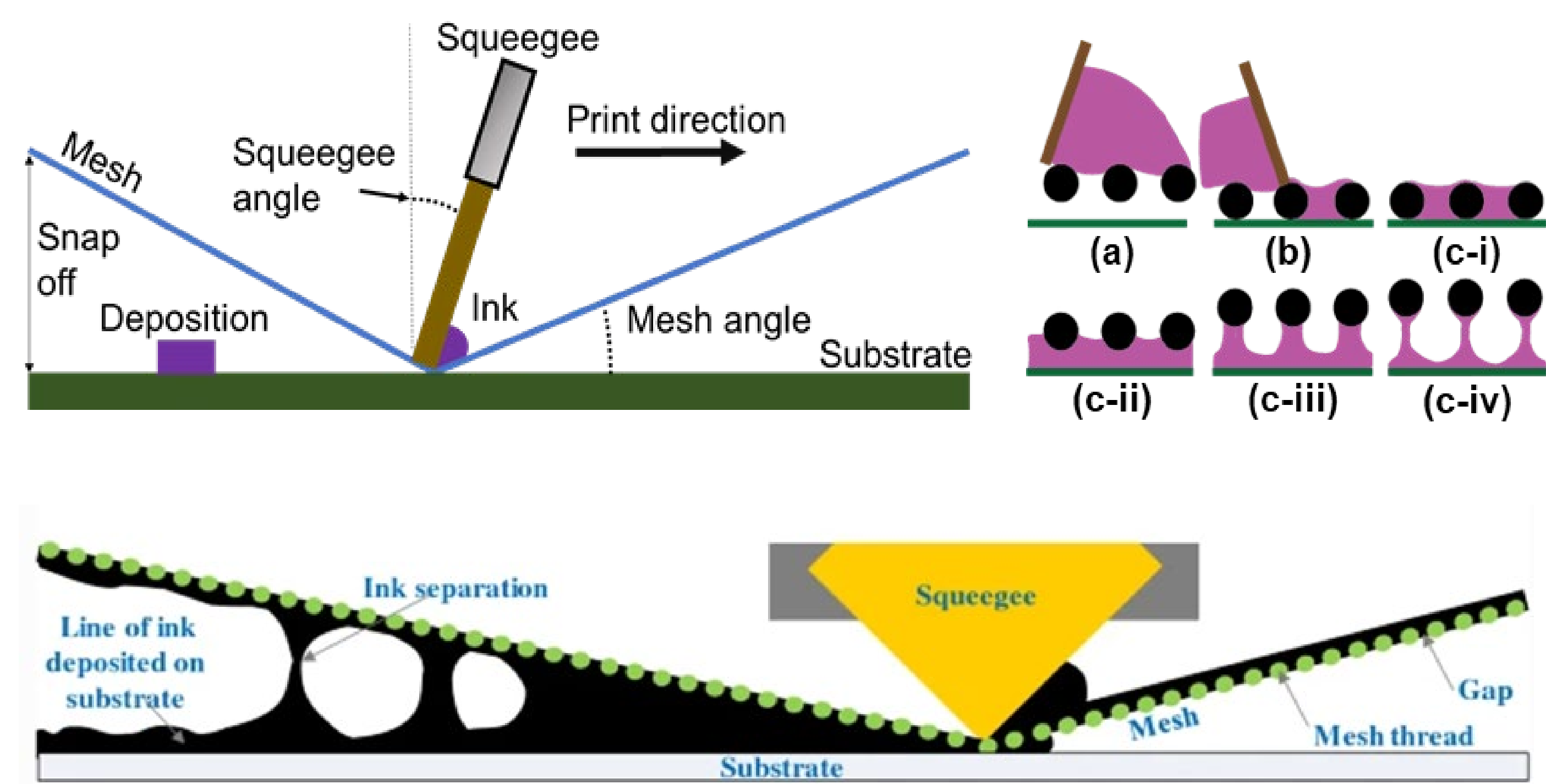
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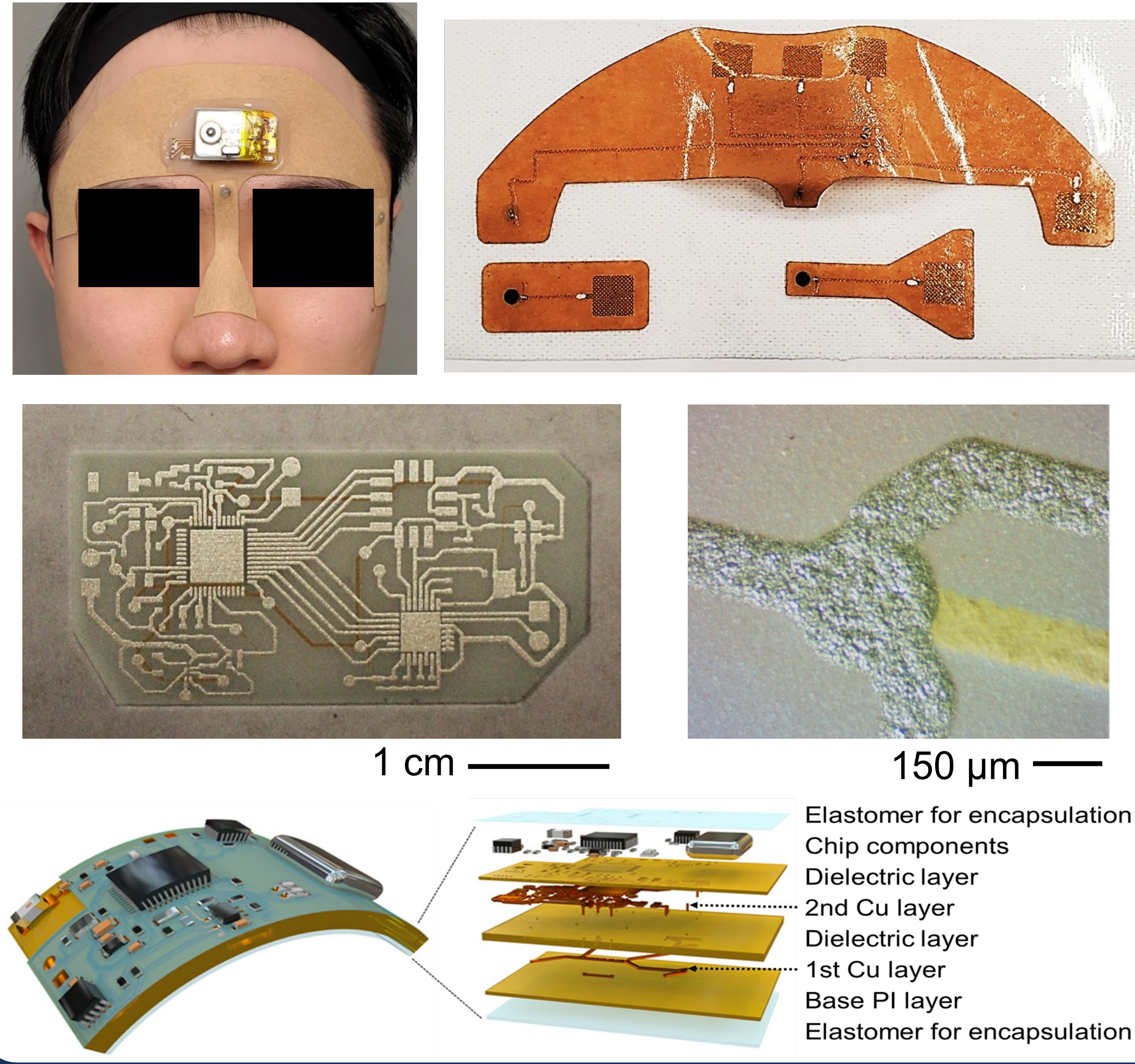
Motivation

- Flexible and functional bioelectronics have demonstrated transformative potential for long duration, portable health monitoring, but they are difficult to fabricate.
- Screen printing offers a high throughput and minimal complexity alternative to traditional photolithographic process and is well suited for industrial scale manufacture.

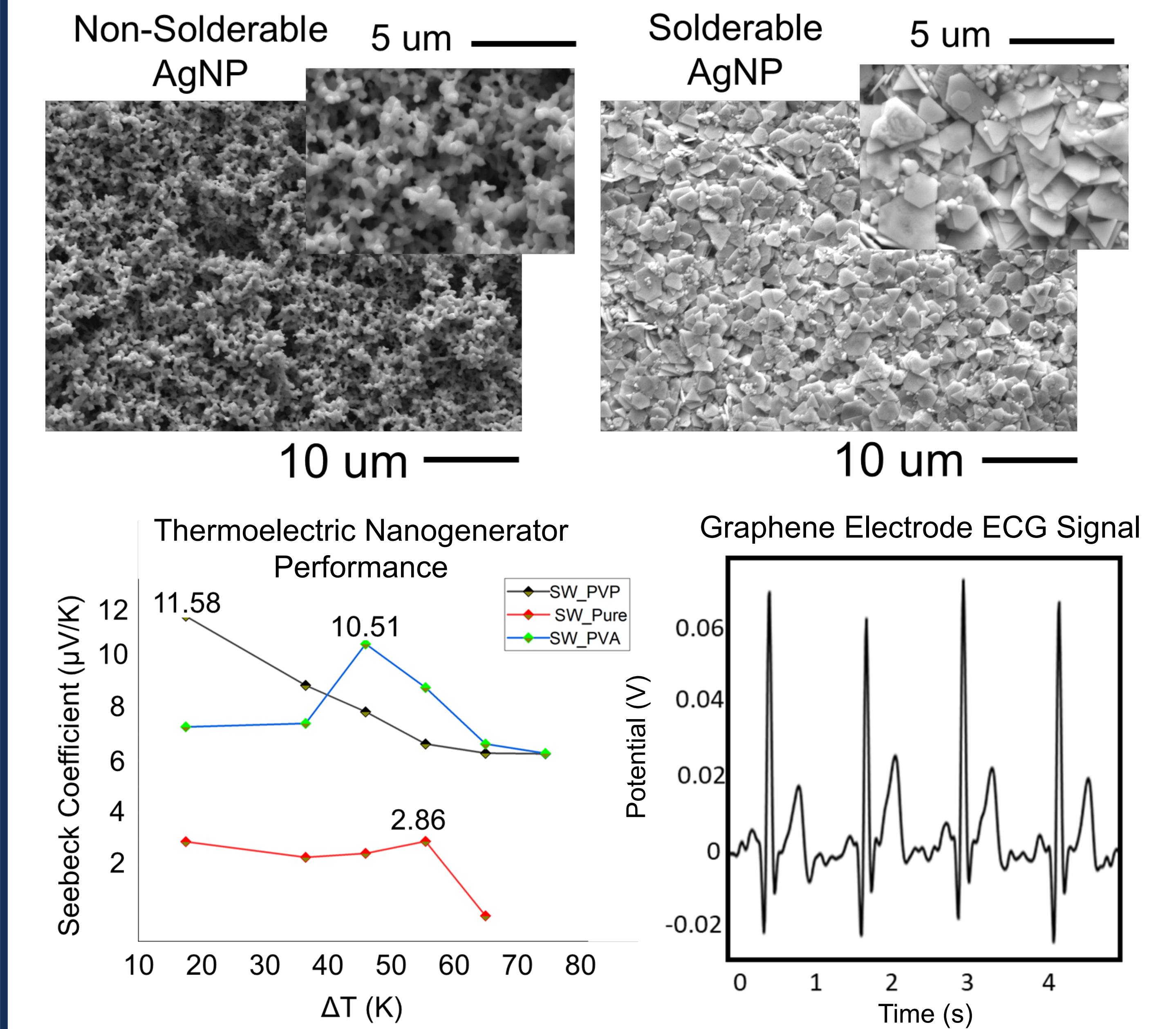
Methods



Electronic Circuitry



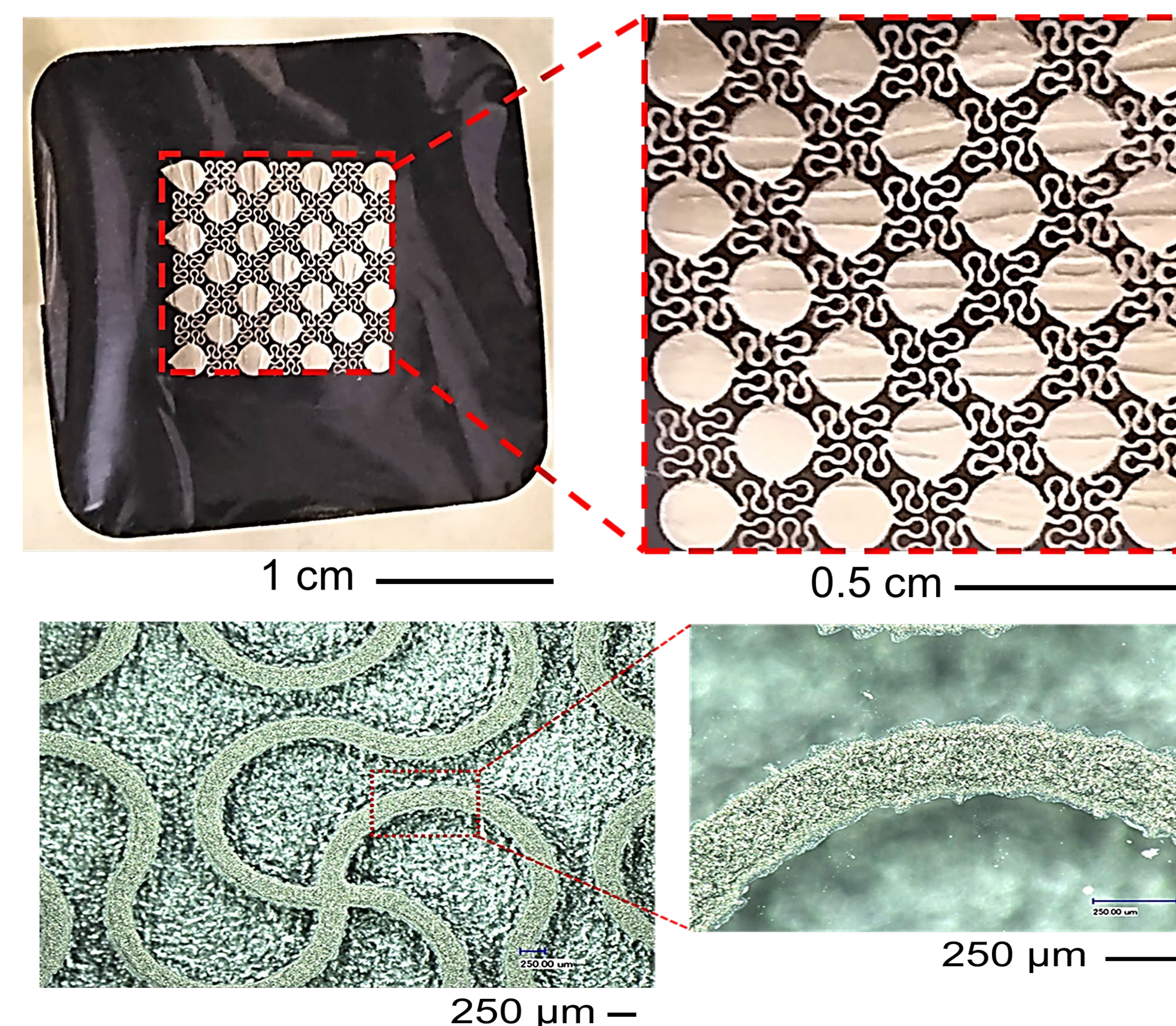
Characterization and Results



Nanomaterial Ink Printing

Ink	Applications	Min Trace	Performance
AgNPs	Interconnects	60 μm	< 0.1 Ω / sq
TPU-AgNP	Stretchable interconnects	70 μm	> 70% strain
Cu	Interconnects	60 μm	< 0.1 Ω / sq
AgNWs	Strain gauges, interconnects	60 μm	> 20 GF
Polyimide	Structural dielectric	100 μm	No leakage with 3 μm height
P-SWCNTs	P-type semiconductor	100 μm	Thermoelectric generator: 168% ΔV from 40-80 C
N-SWCNTs	N-type semiconductor	100 μm	
Graphene	Biopotential transduction	70 μm	> 20 SNR ECG
Carbon Black	Strain gauge enhancement	70 μm	> 40 GF
PVDF-TrFE	Piezoelectric pressure sensor	80 μm	20 pC/N d33

Biopotential Electrodes



Conclusions

- We have demonstrated high precision screen printing of functional nanomaterials to enable fabrication of highly functional biopotential electrodes, thermoelectric nanogenerators, flexible circuits, semiconductors, printed vias, solderable circuit pads, strain gauges, and pressure sensors.

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