ZnO/Au Hybrid Layered Structure on Silk Textile Prepared by Supercritical CO_2 Promoted Electrodeposition for Applications in Flexible Multifunction Electronic Devices

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• Motivation & Introduction •

1. Functional wearable devices

Silk → Au/Silk → ZnO/Au/Silk

Flexibility Conductivity Functionality

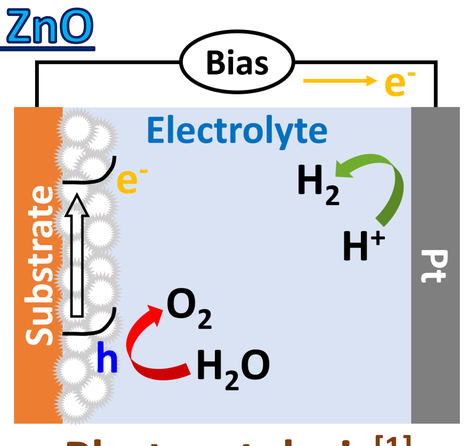
2. Merits of Au [2]

- Biocompatibility
- Ductility
- Corrosion

3. Silk

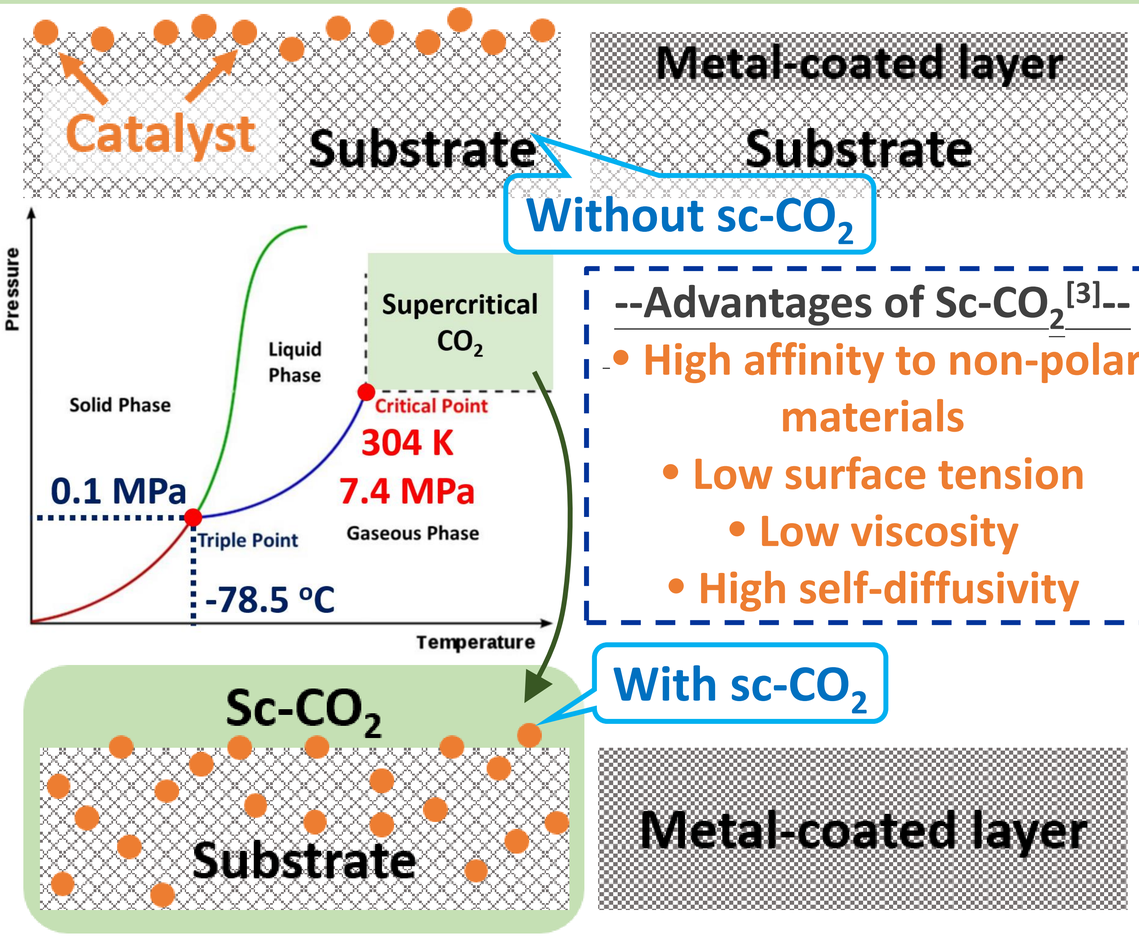
- Stretchability
- Biocompatibility

4. ZnO



Photocatalysis[1]

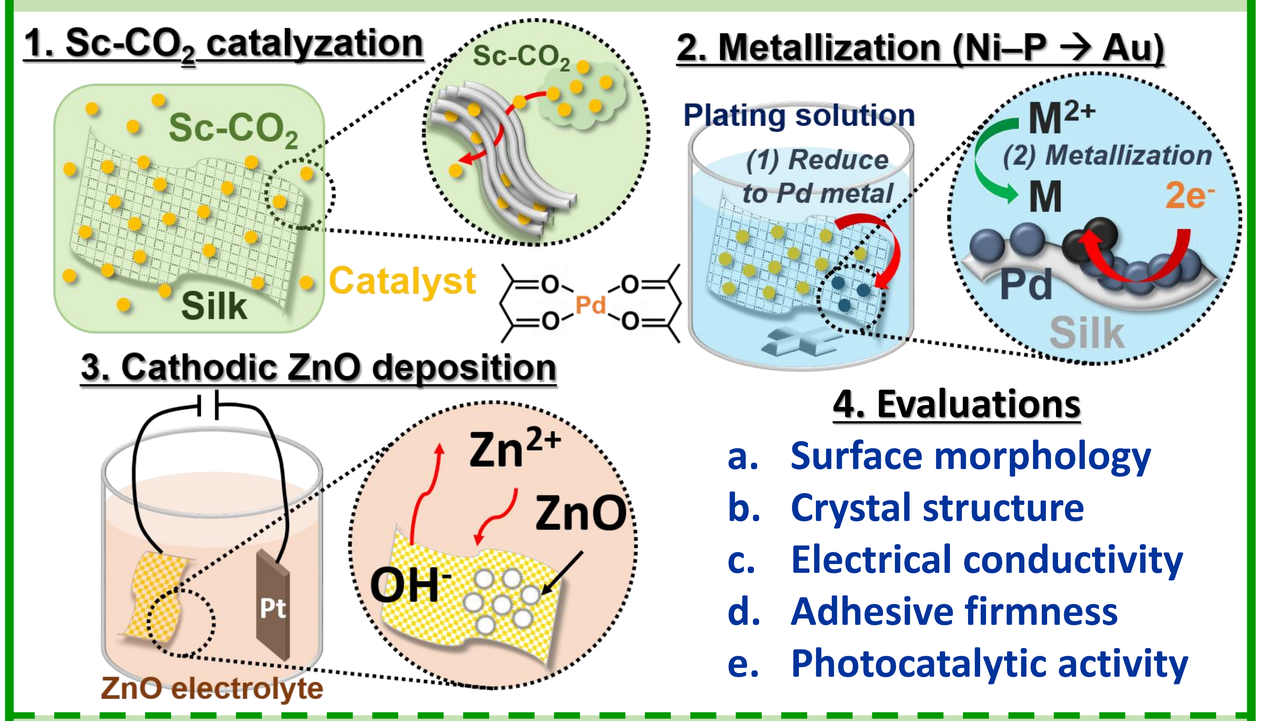
• Supercritical CO_2 (Sc-CO_2) assisted step •



--Advantages of Sc-CO_2 [3]--

- High affinity to non-polar materials
- Low surface tension
- Low viscosity
- High self-diffusivity

• Experimental procedures •



• Results and Discussion I – Metallization •

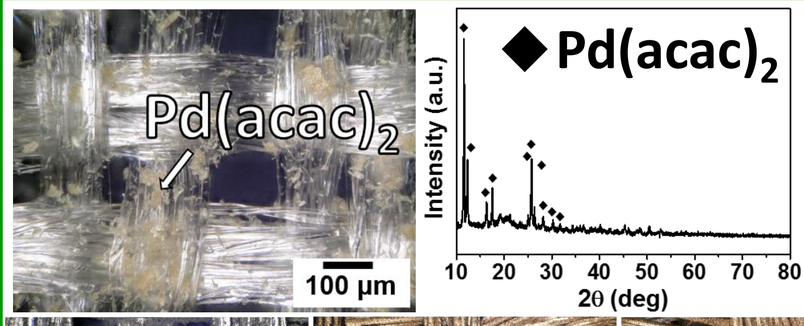


Fig. 1 (a) OM image and (b) XRD pattern of silk textile after sc-CO_2 catalyzation.

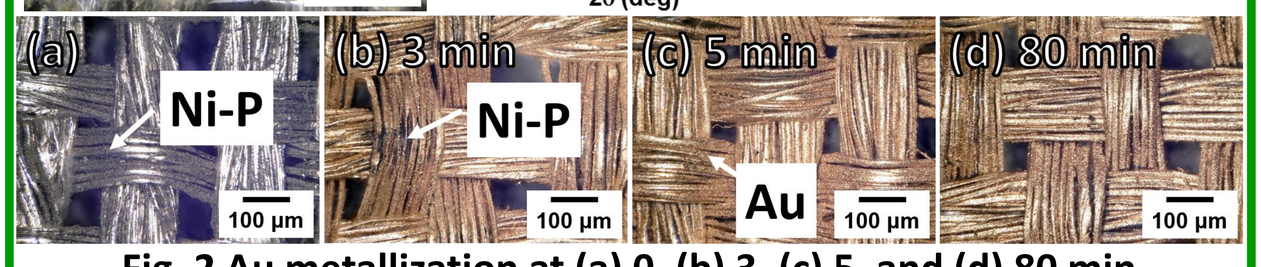


Fig. 2 Au metallization at (a) 0, (b) 3, (c) 5, and (d) 80 min.

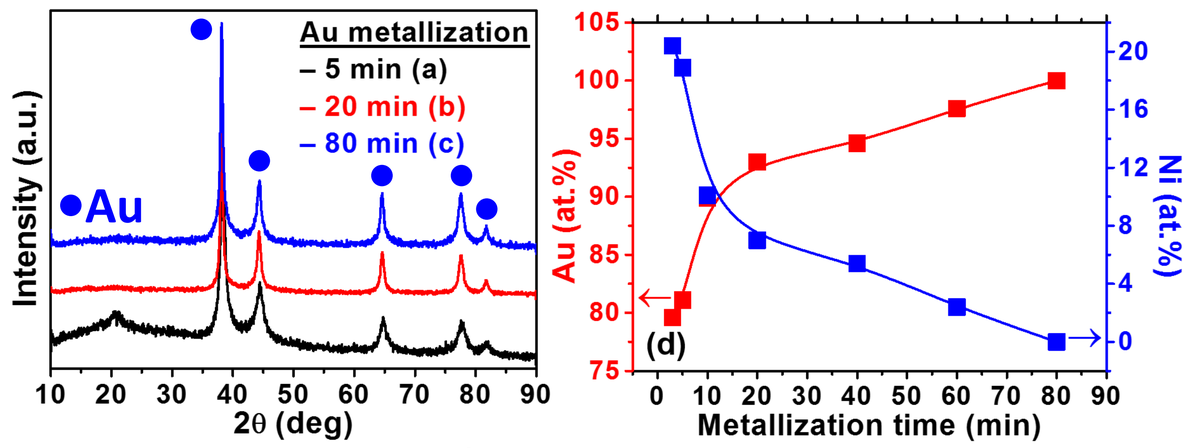


Fig. 3 XRD patterns of Au/silk at the metallization time of (a) 5, (b) 20, and (c) 80 min and (d) composition of Au/silk composite.

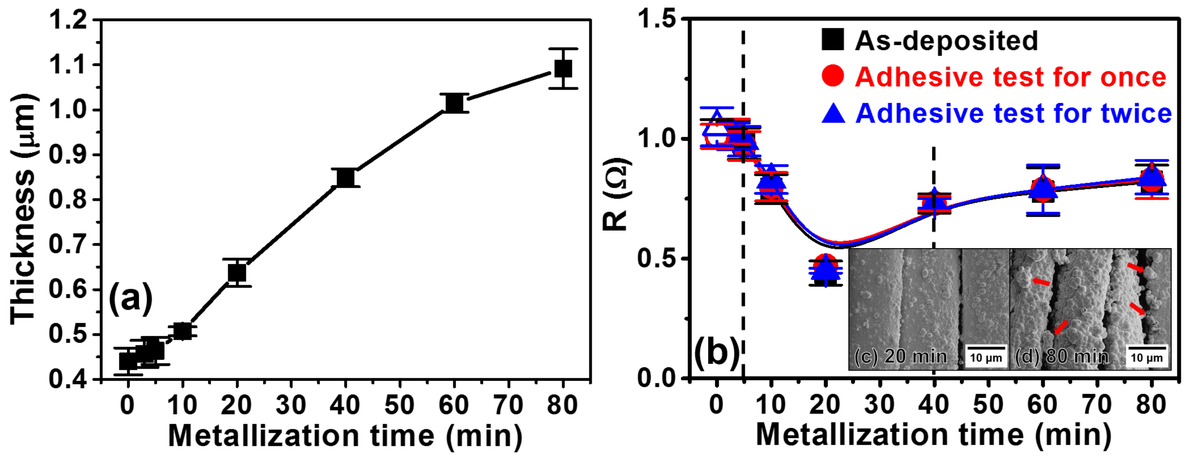


Fig. 4 (a) Au thickness – metallization time, (b) electrical resistance of Au/silk, and SEM images at metallization of (c) 20 and (d) 80 min.

• Results and Discussion II – ZnO deposition •

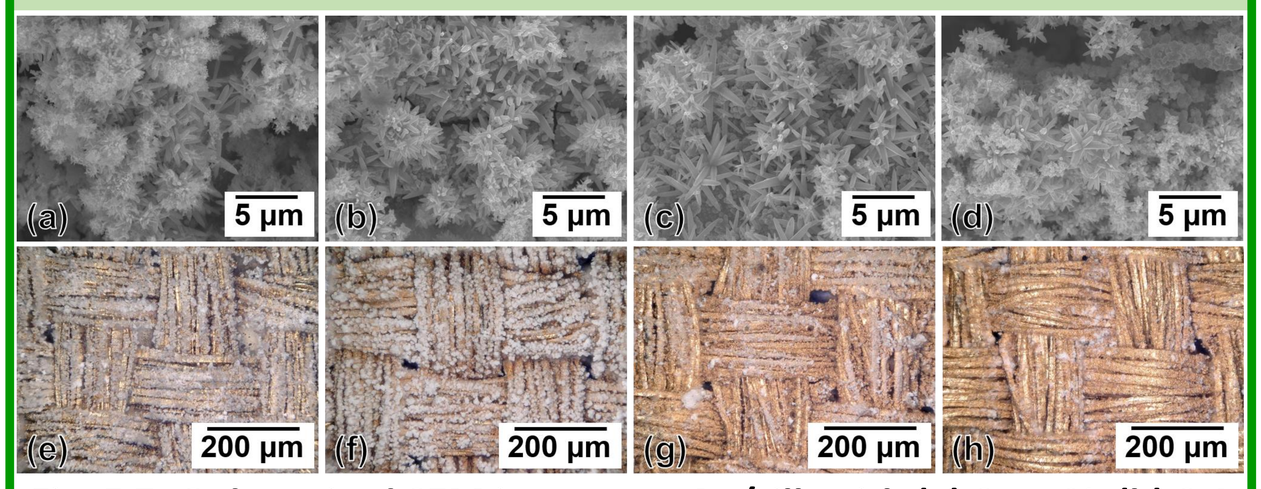


Fig. 5 ZnO deposited SEM images on Au/silk with (a) 0 wt.%, (b) 0.1 wt.%, (c) 0.2 wt.%, and (d) 0.3 wt.% and OM images on Au/silk with (a) 0 wt.%, (b) 0.1 wt.%, (c) 0.2 wt.%, and (d) 0.3 wt.% [H_2O_2].

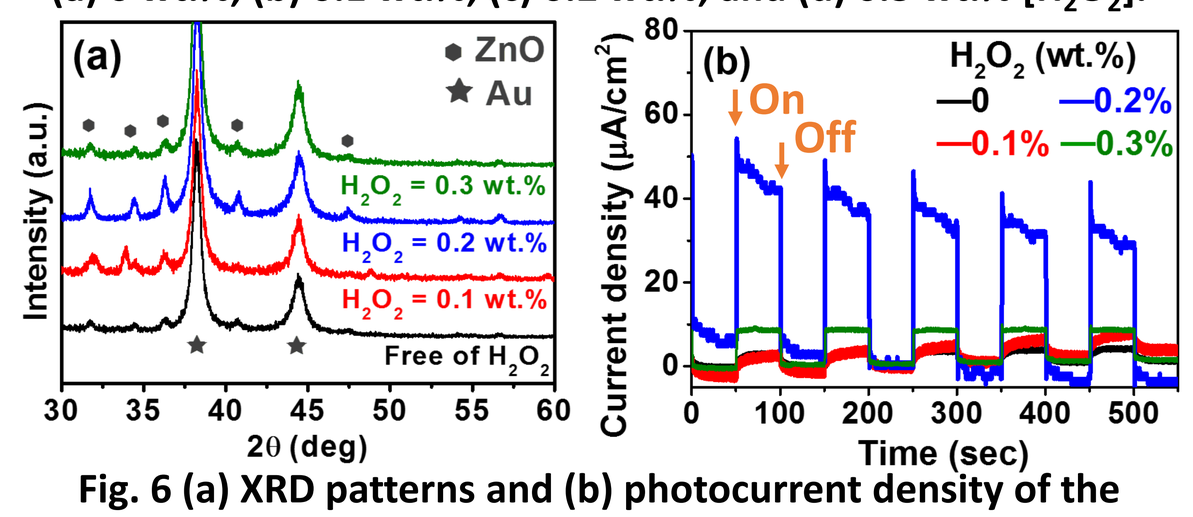


Fig. 6 (a) XRD patterns and (b) photocurrent density of the ZnO/Au/silk hybrid materials in 0.5 M Na_2SO_4 with various [H_2O_2].

• Conclusions •

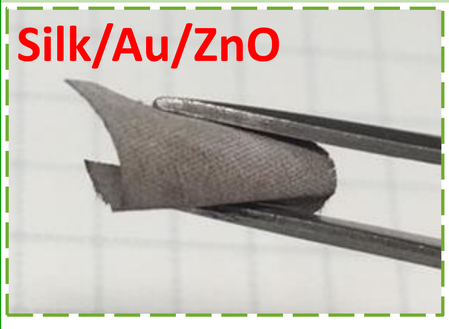


Fig. 7 Silk/Au/ZnO composite material

1. Flexible, conductive, and photocatalytic composite Silk/Au/ZnO materials.
2. Integration of ZnO (functional material) and silk textile (cloth material) together to make the materials close to daily life.
3. Photocurrent density enhanced 11.5 times with the optimized deposition electrolyte by cathodic deposition.

Ref: [1] B.R. Sankapal, H.B. Gajare, S.S. Karade, R.R. Salunkhe, D.P. Dubal, Electrochim. Acta 192 (2016) 377-384.
[2] H.M. Lee, M. Ge, B. Sahu, P. Tarakeshwar, K.S. Kim, J. Phys. Chem. B 107 (2003) 9994-10005.
[3] H. Adachi, K. Taki, S. Nagamine, A. Yusa, M. Ohshima, J. Supercrit. Fluids 49 (2009) 265-270.

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