

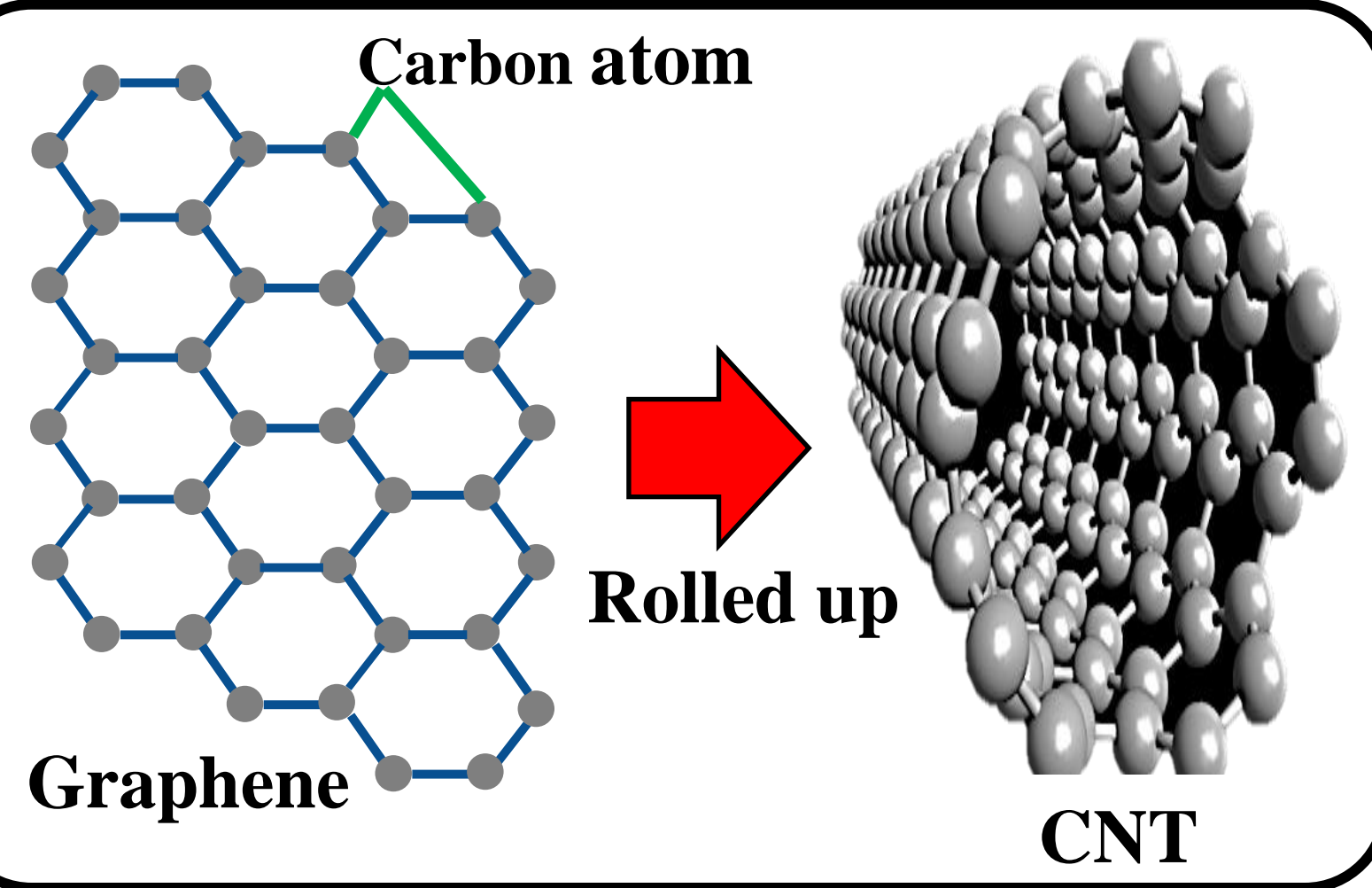
# Fabrication of Au/SWCNT/Au Schottky Junction using Dry Film Photolithography

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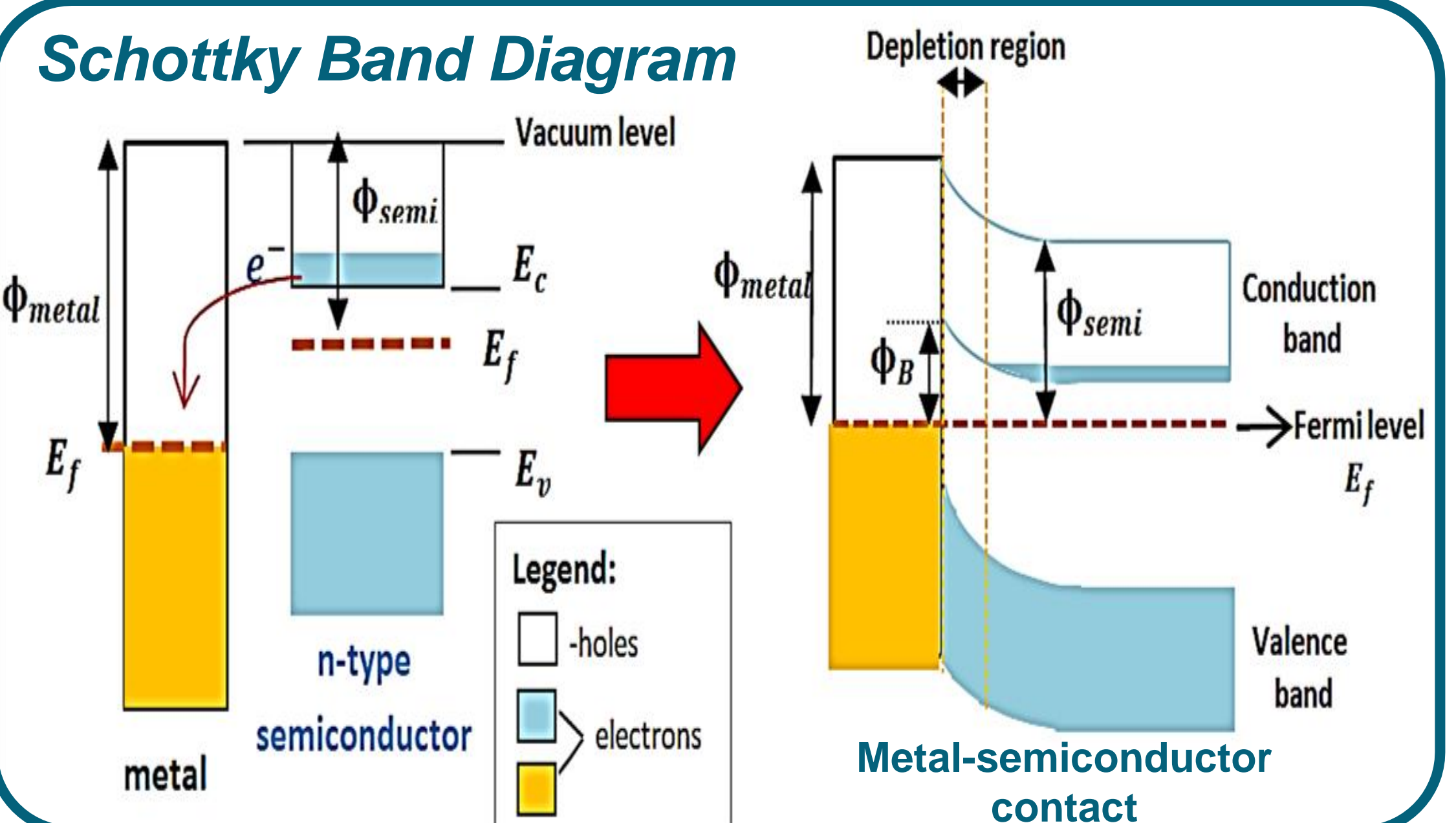
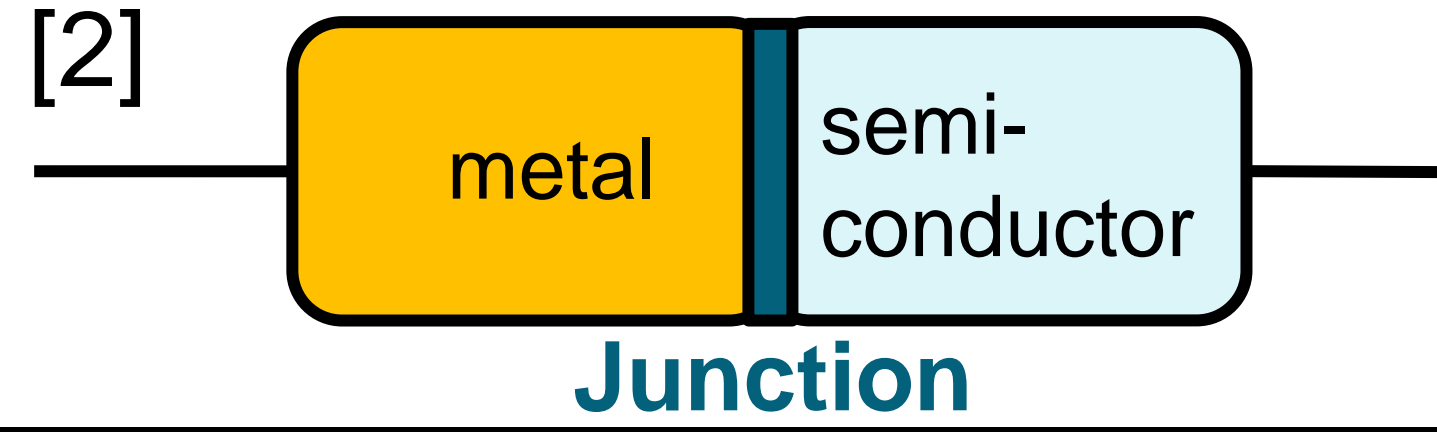


## Background



▪ CNT is a one dimensional (1D) form of carbon where atoms are arranged in hexagonal patterns and its cylindrical structure is formed by rolled graphene (single layer of graphite) with a diameter and length of the order of nanometers. [1]

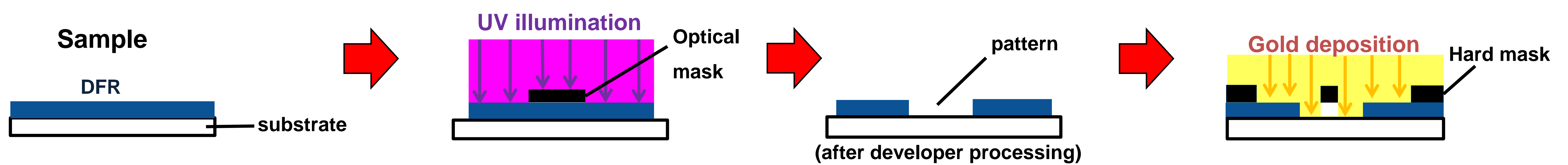
▪ **Schottky junction** is a junction formed through metal and semiconductor contact. [2]



**Objective:** Fabricate a Schottky junction device based on single-walled carbon nanotubes (SWCNTs) and Au electrodes by utilizing photolithography on a dry film photoresist (DFR). To know if the a junction is formed in the Au-SWCNT interface, we measure the channel resistance of the fabricated device using a multimeter.

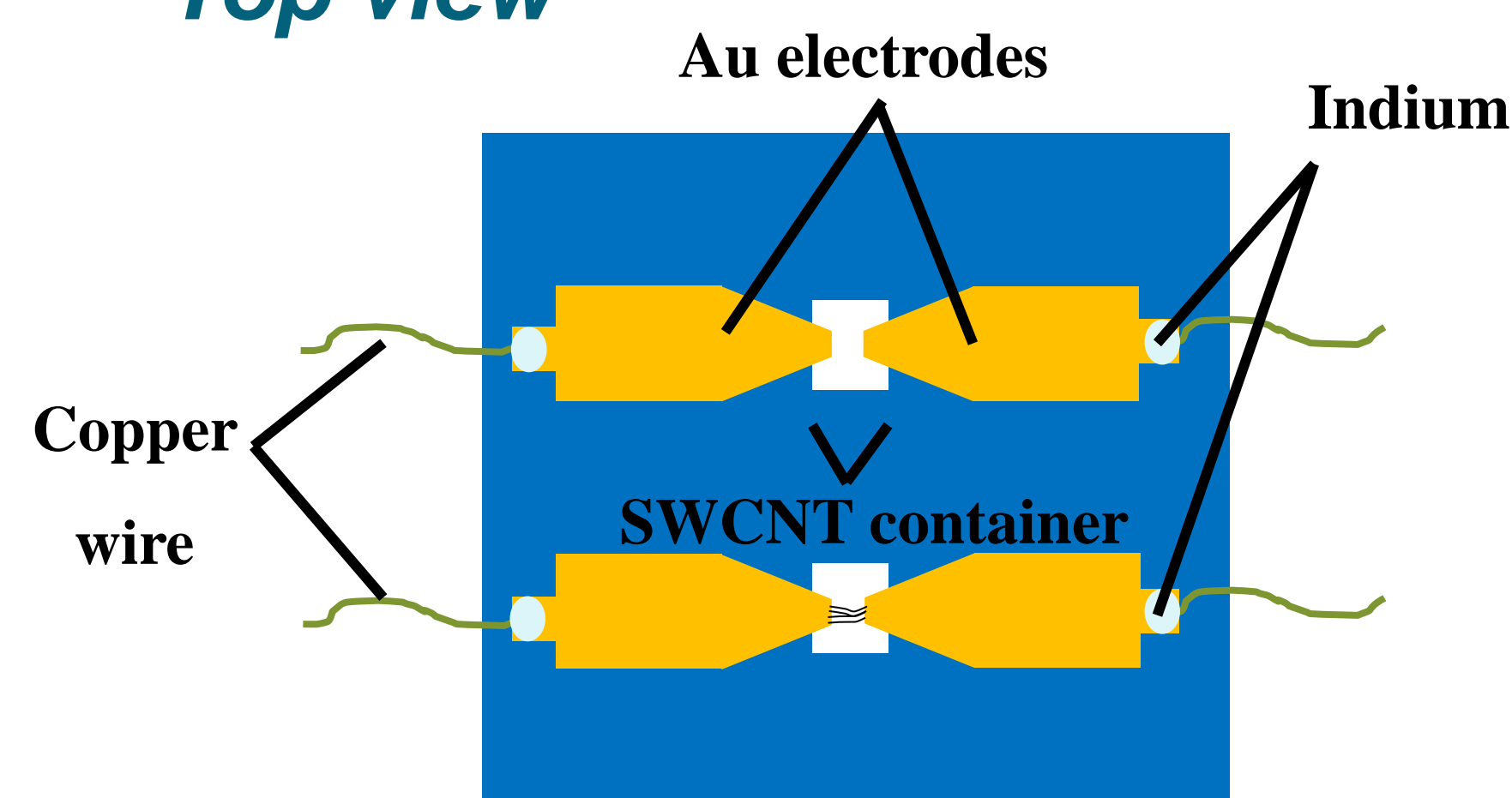
## Experimental

### Sample Preparation

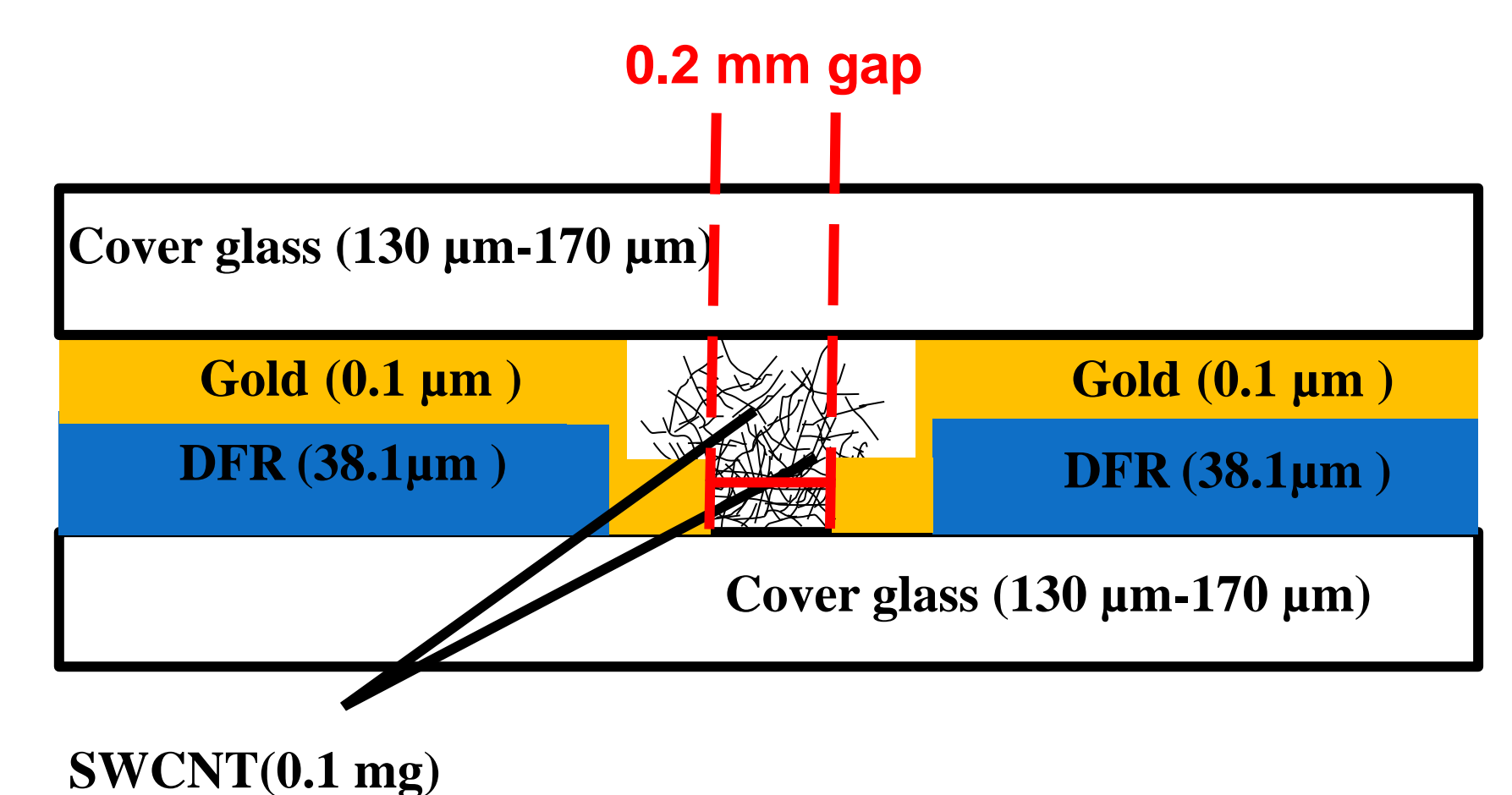


- Preparation of dry film photoresist (DFR)
- Construction of mask using CAD
- Lamination at 120°C for 120 sec
- Photolithography: UV illumination for 100 sec at fixed working distance (WD) of 30 cm
- Developer solution ( $K_2CO_3 + H_2O$ )
- Deposition: Gold sputtering
- Direct SWCNT powder attachment
- Measuring the channel resistance across the device

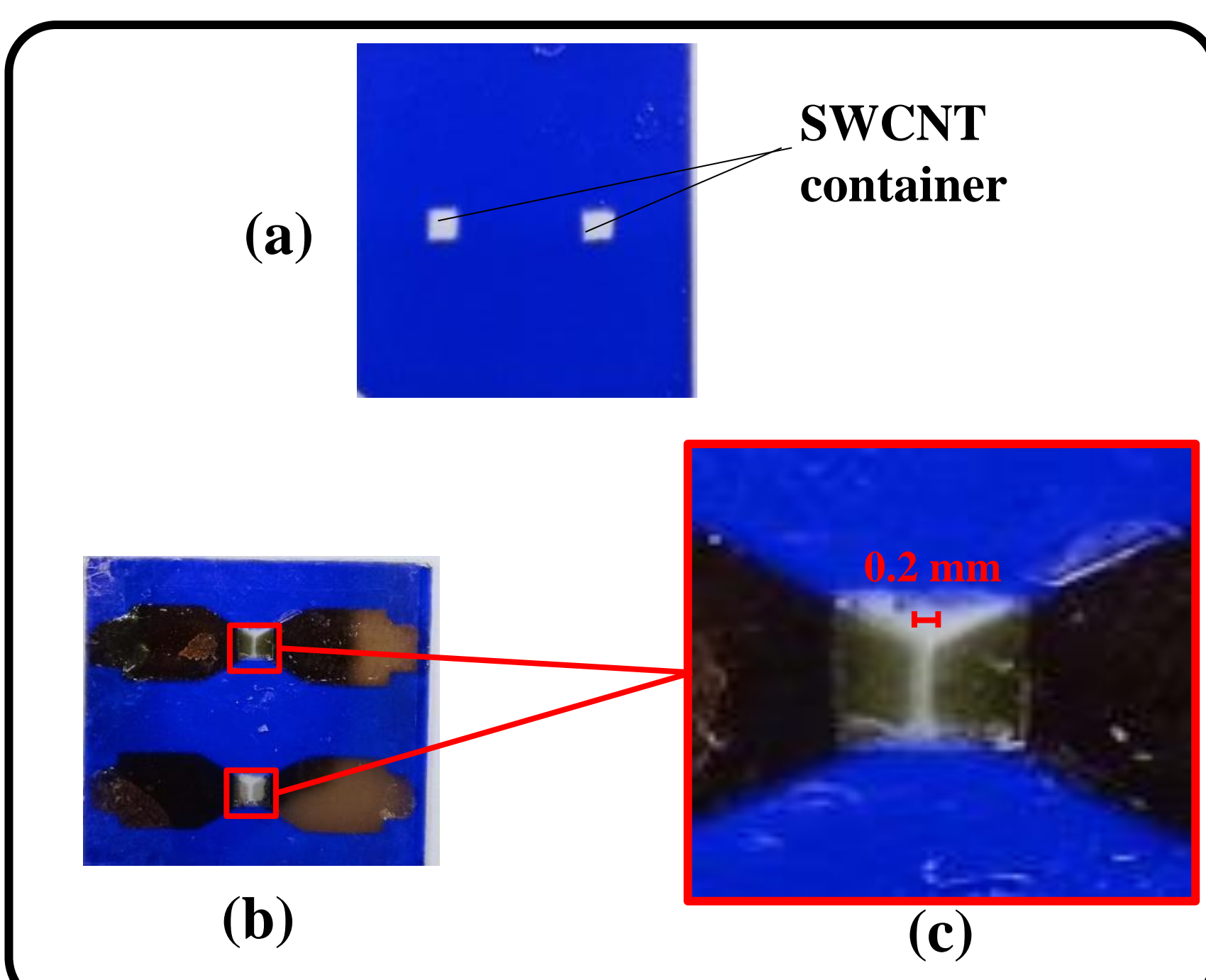
#### Top view



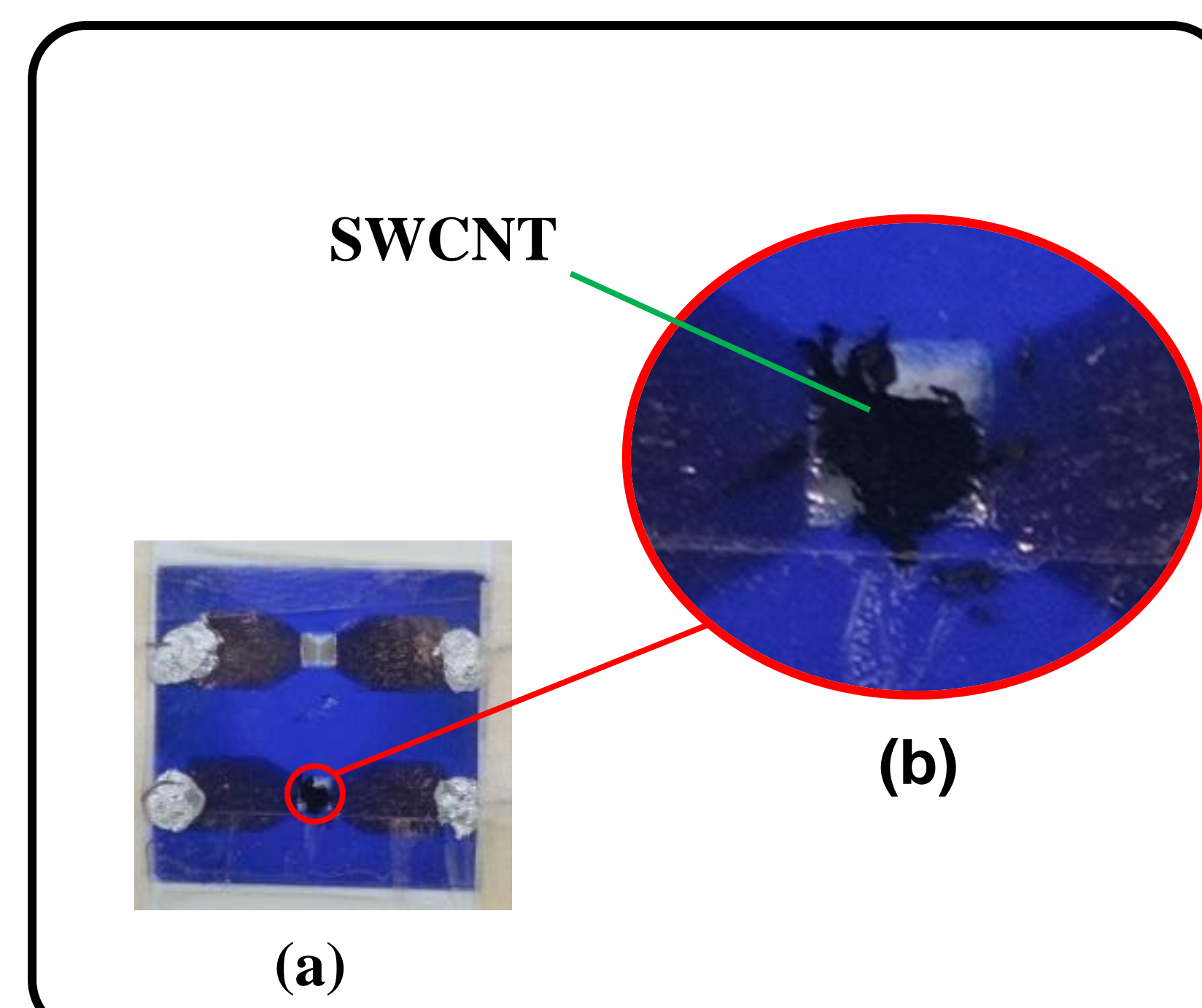
#### Side view



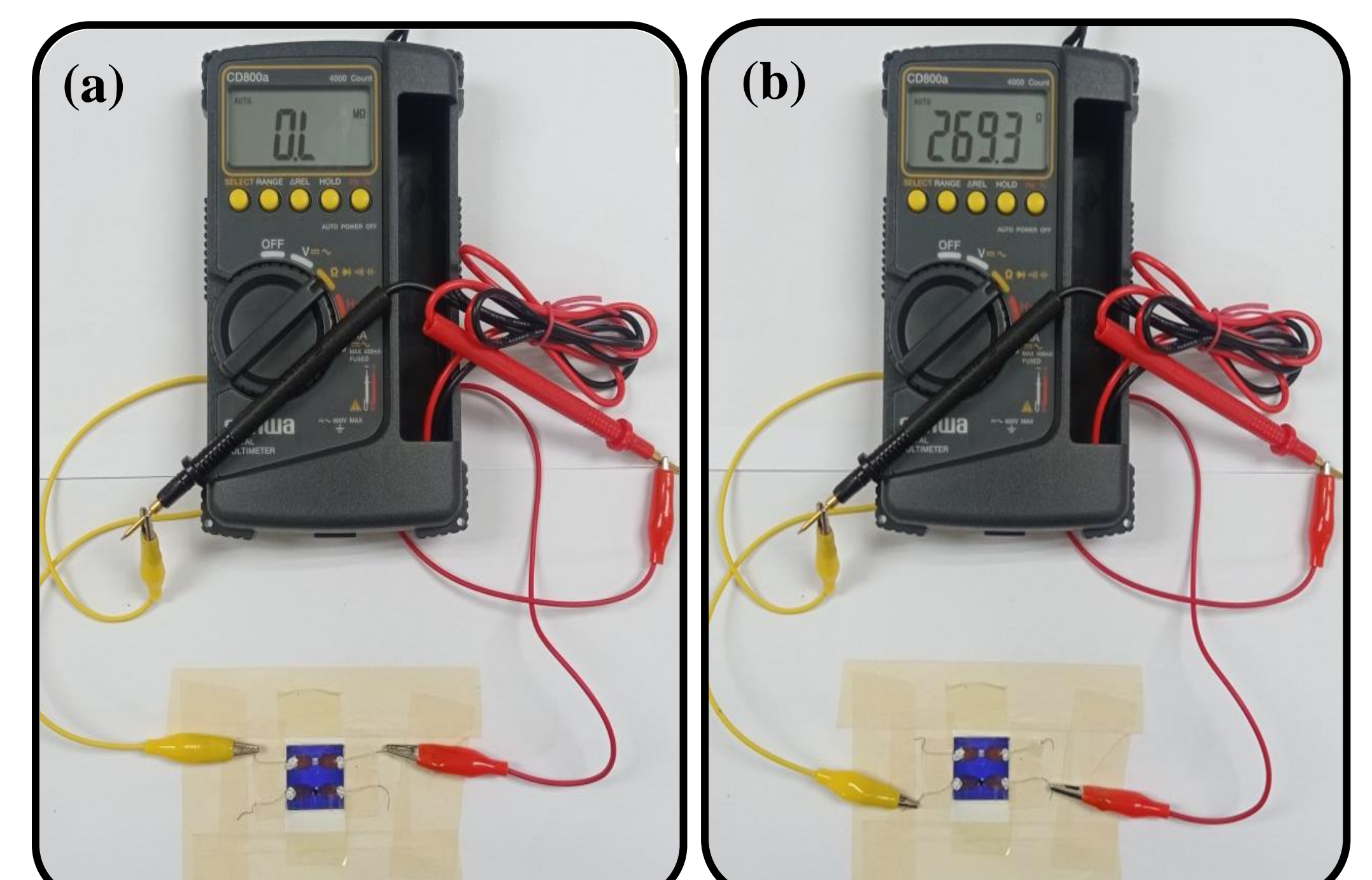
## Results and Discussions



- In (a) the SWCNT container was formed through photolithography.
- (b) The 100 nm thick Au electrodes were successfully deposited into the DFR with (c) 0.2 mm gap and has great adhesion into the DFR.



- (a) The 0.1 mg SWCNT powder was successfully deposited into the gap through direct deposition.
- (b) The SWCNTs are bundled and highly tangled-up.



- In (a) without SWCNT deposited into the gap the resistance was infinite.
- With deposited SWCNT in the electrode gap, (b) the channel resistance was 269.3 Ω.

## Summary

- We were able to successfully make a SWCNT container using DFR through photolithography.
- The 100 nm thick Au electrodes were successfully deposited into the DFR. It was observed that Au has great adhesion to DFR and the pattern from the hard mask is accurately printed into the developed sample achieving the gap of 0.2 mm.
- Furthermore, we were able to successfully bridge the 0.2 mm gap through direct deposition of SWCNTs and the measured channel resistance was 269.3 Ω Hence, we were able to successfully fabricate a junction at the Au-SWCNT interface.

## References

- [1] Aqel, A., et al. "Carbon nanotubes, science and technology part (I) structure, synthesis and characterisation." *Arabian Journal of Chemistry* 2012: 5(1), 1–23.
- [2] "Schottky diode or Schottky barrier semiconductor diode." *Basic Electronics Tutorials*. 14 June 2022. , 2022 July 8 <<https://www.electronics-tutorials.ws/diode/schottky-diode.html>>