

## Printed Display Electronics Based on Separated Carbon Nanotube Inks

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### Motivation & Introduction

#### Q1: Why choosing separated carbon nanotubes (s-CNTs):

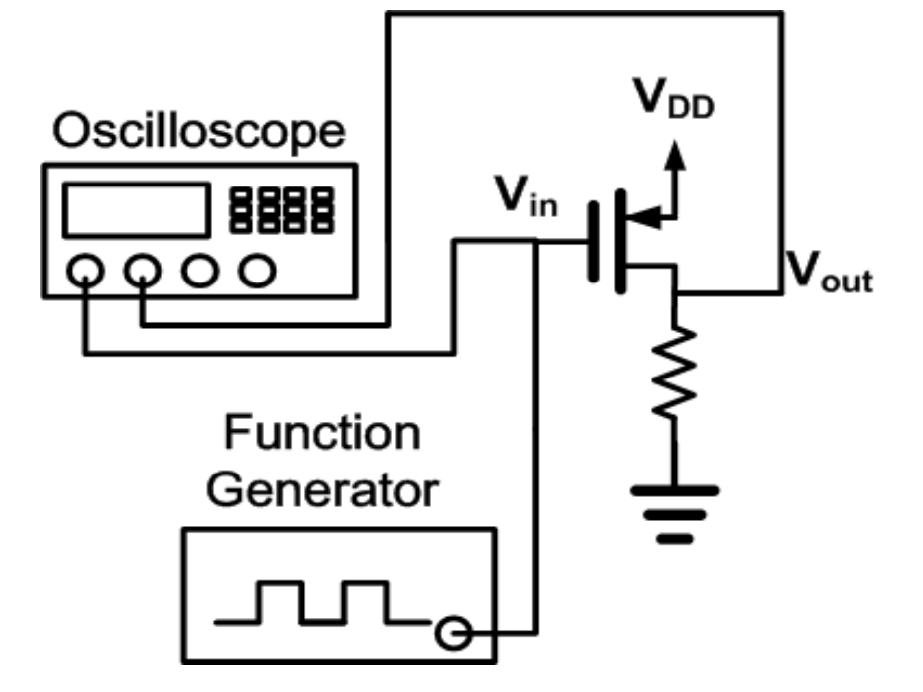
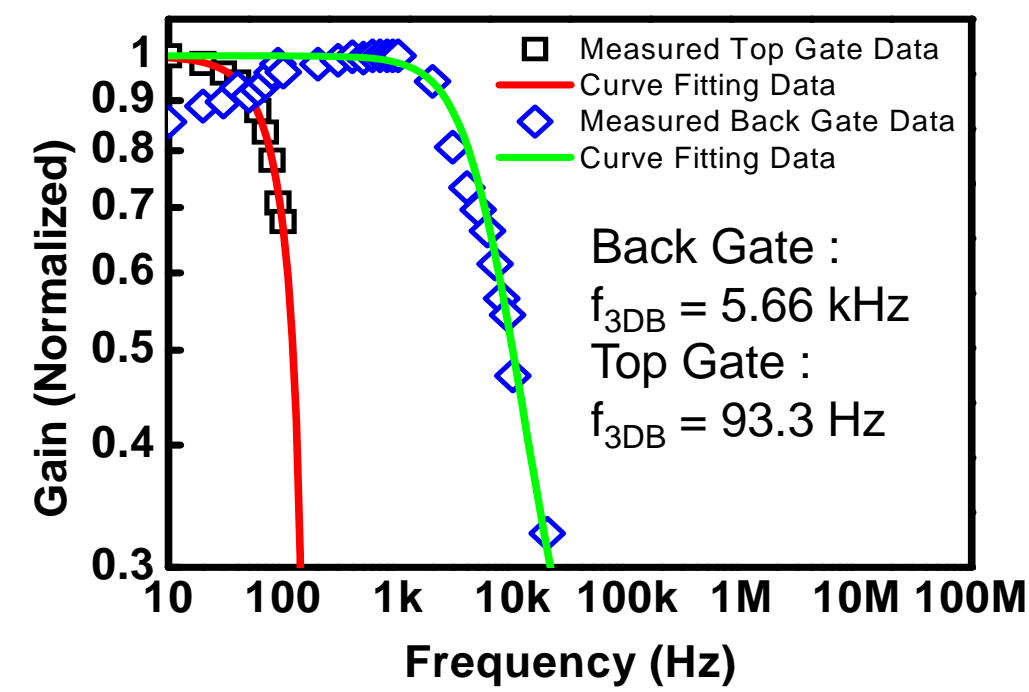
1. Good semiconducting material for thin film transistors: High mobility ( $10\sim 100\text{ cm}^2/\text{Vs}$ ), high on/off ratio ( $10^3\sim 10^5$ ) and small operation voltage ( $1\sim 10\text{ V}$ ).
2. Good candidate for printed electronics and flexible electronics.

#### Q2: Why choosing printing technology:

1. Low cost.
2. High throughput.

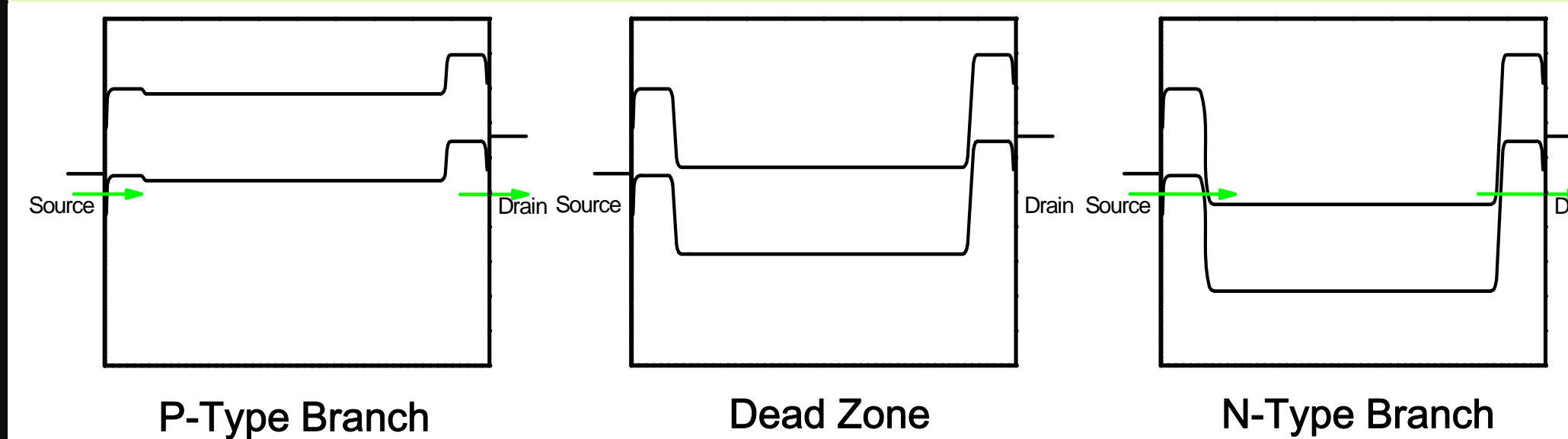
### In Depth Study

#### Frequency Study



- > Commercial display works at 60 Hz.
- > For back gated s-CNT TFT,  $f_{3\text{dB}}$  is 5.66 kHz, while for top gated s-CNT TFT,  $f_{3\text{dB}}$  is 93.3 Hz.

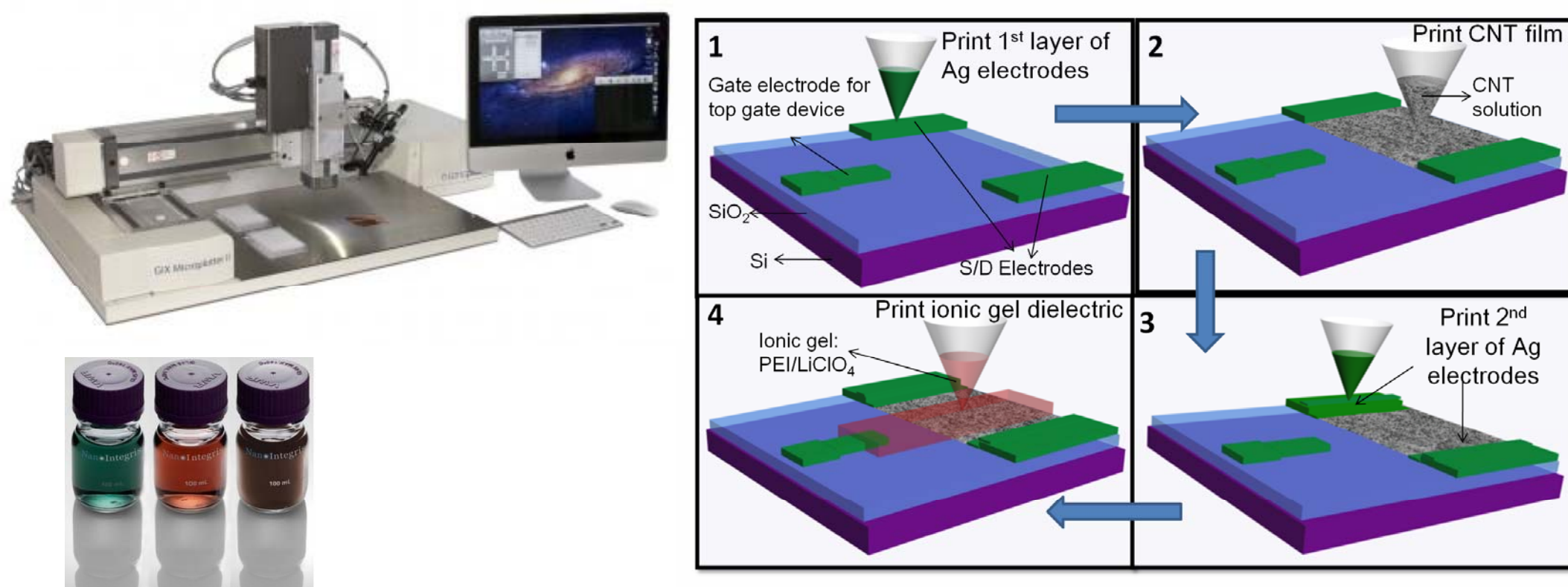
#### Explanation for Ambipolar Transport



### Experimental Setups

#### Printing Facility

#### Printing Process

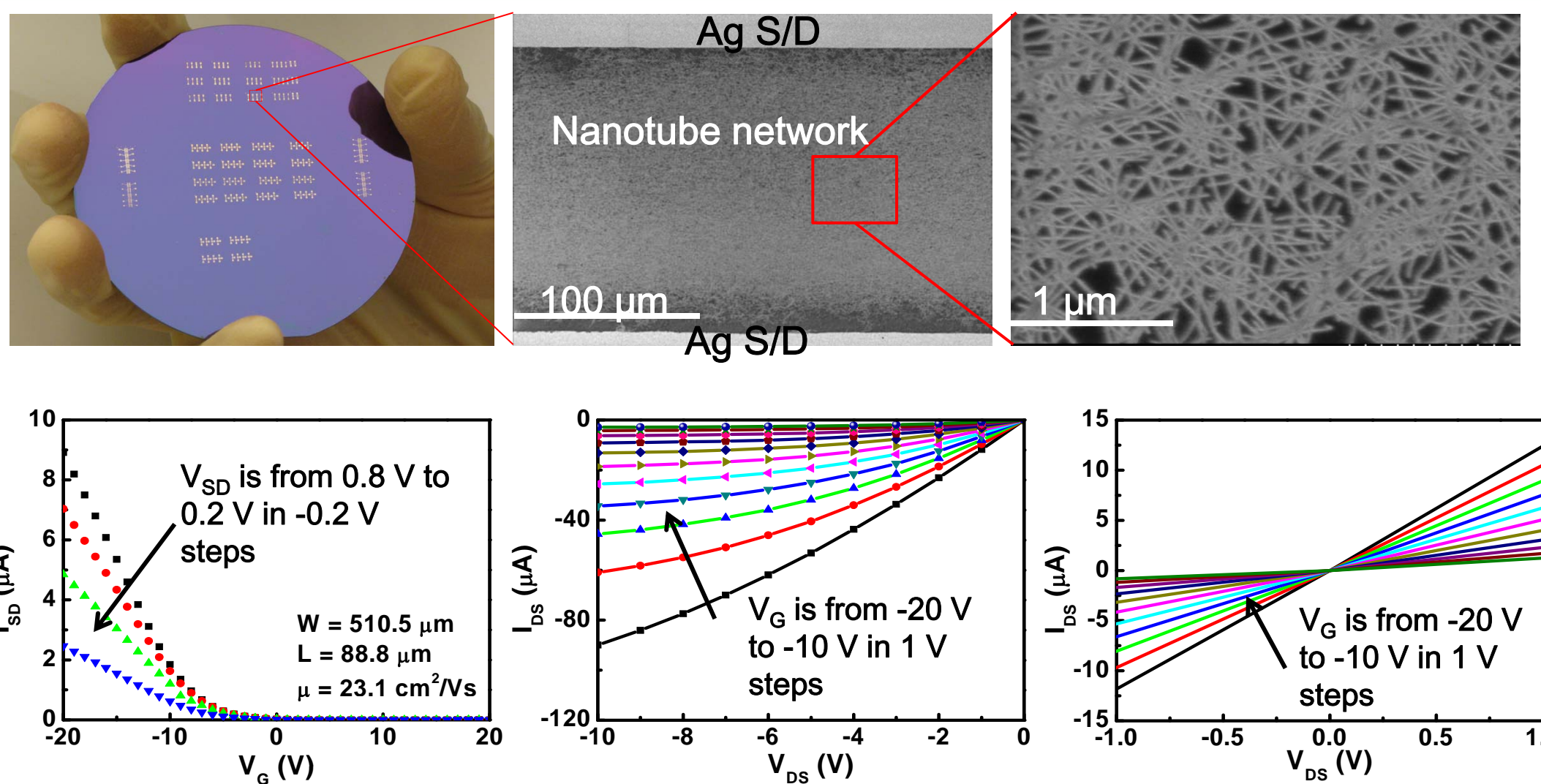


### Printable Ink Engineering

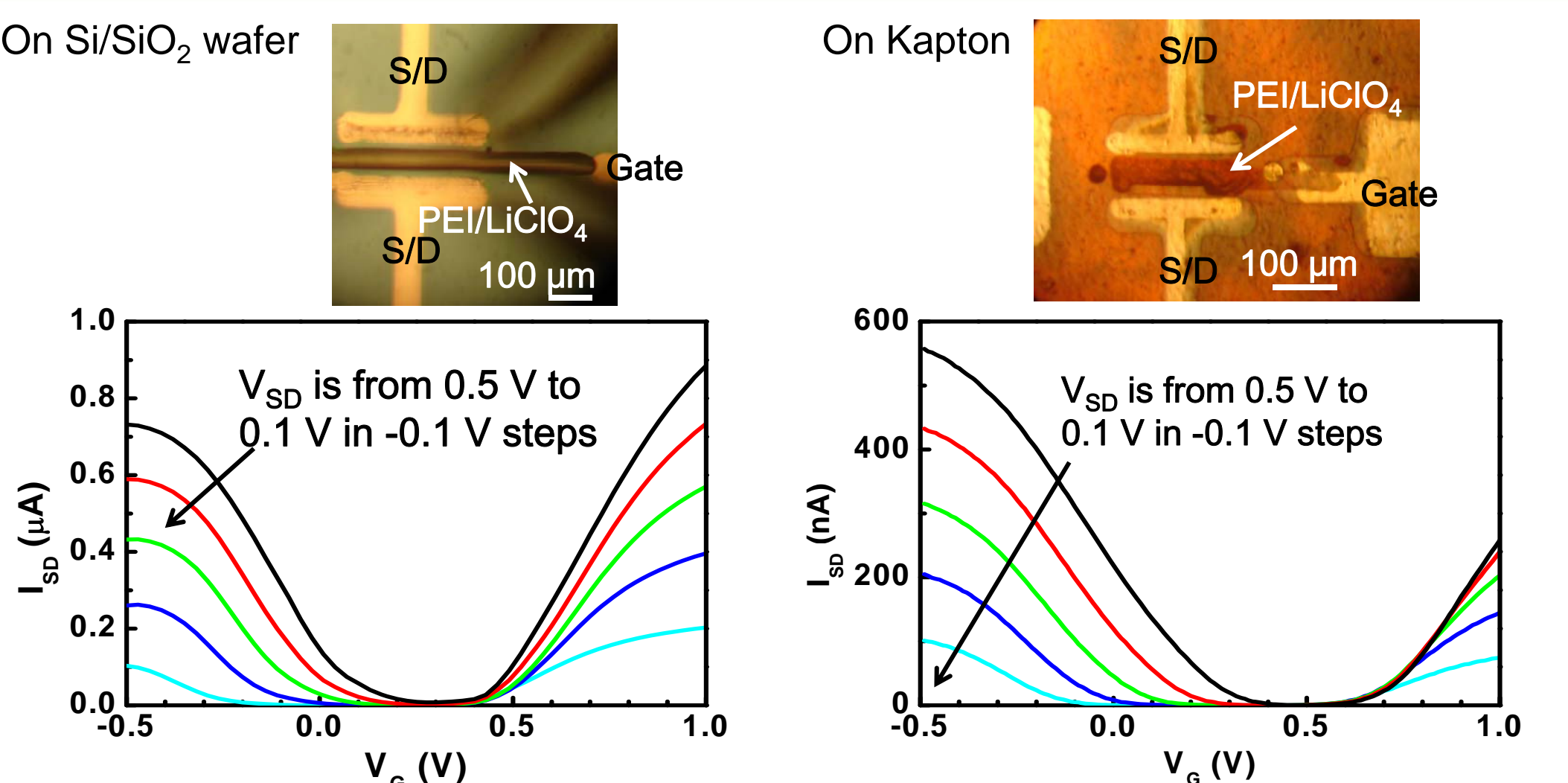
Find proper printable inks for printed thin film transistors (TFTs):

- ✓ Conductive electrodes: silver nanoparticle solution.
- ✓ Semiconducting material: semiconducting-enriched s-CNT solution
- ✓ Gating material: PEI/LiClO<sub>4</sub>

#### Wafer Scale Fabrication of Single Back Gated s-CNT TFTs

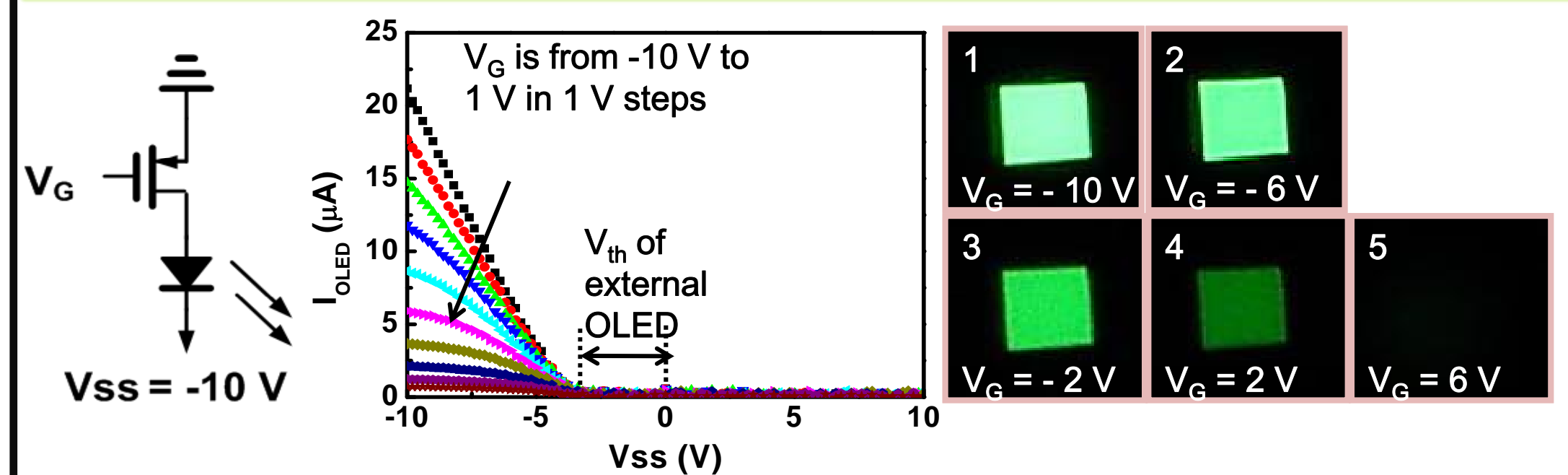


#### Single Top Gated s-CNT TFTs

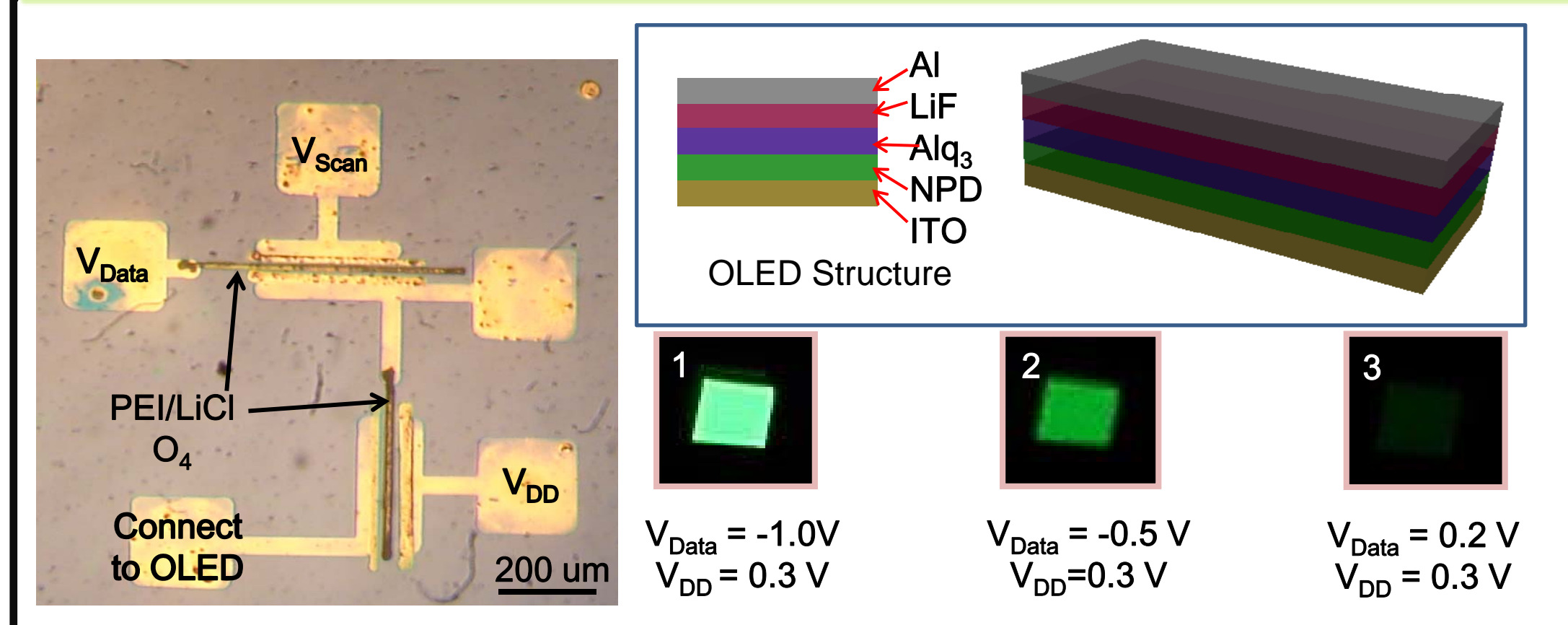


### Pixel Driving Circuits

#### 1T OLED Driving Circuit

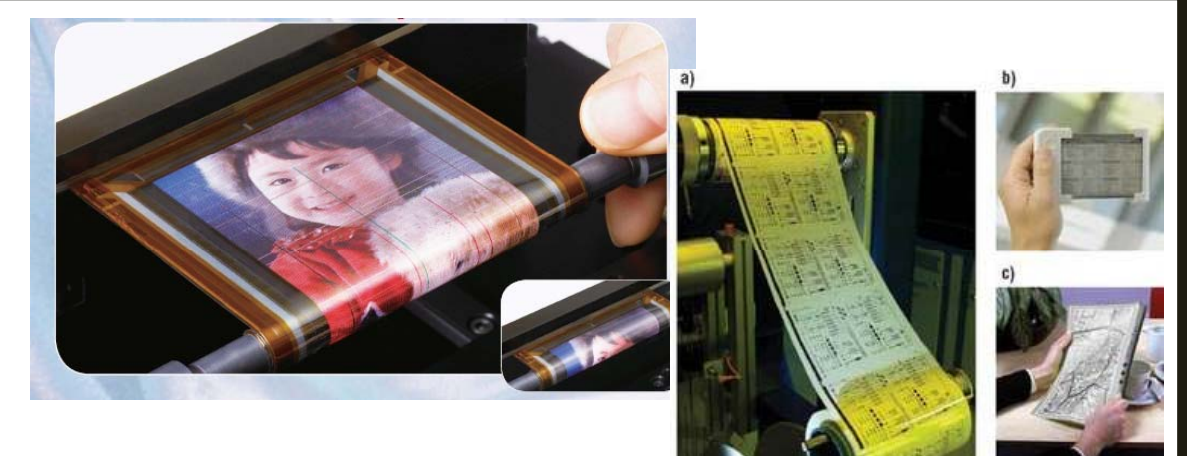


#### 2T OLED Driving Circuit



### Prospect

1. Printed integrated flexible display.



2. Printed, flexible electronics based on thin film transistor circuits, for example, sensor, flash memory and CPU, etc.

