

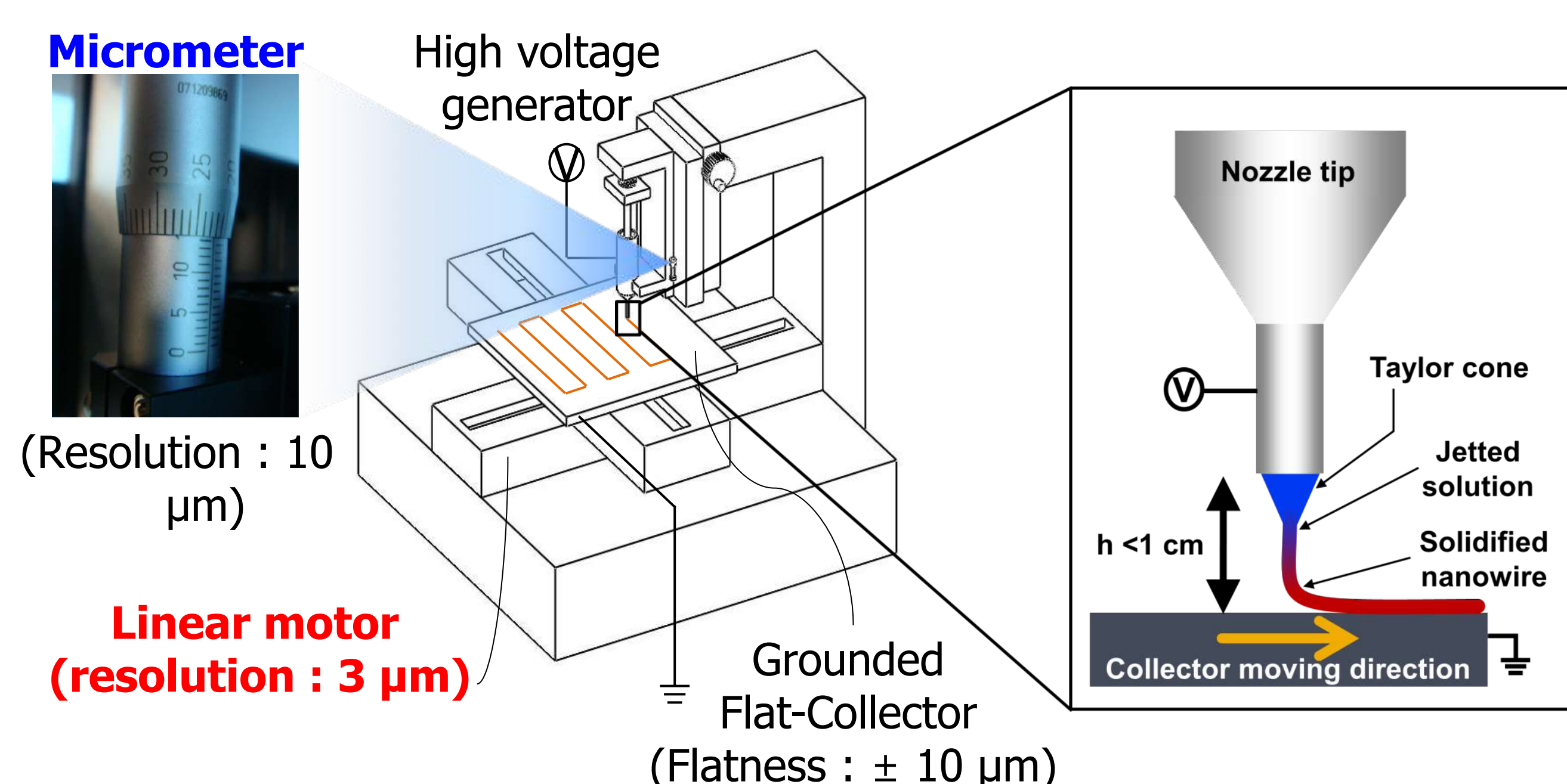
Electric field aided robotic nozzle printer and method for fabrication of organic nano structure

Research Background

- Conventional vertically grown inorganic semiconductor nanowires are making it difficult to fabricate large-area-aligned or -patterned electronic devices on a substrate.
- Organic materials are good for mass production, low-cost solution process and easy control of molecular and electrical characteristics.
- Because conventional organic nanowire fabrication methods are difficult to control the size and number of organic nanowires, it is very difficult to produce reliable applications.
- Electrospinning can easily produce nanowires, but it is difficult to obtain aligned nanowires due to an unstable electric field.

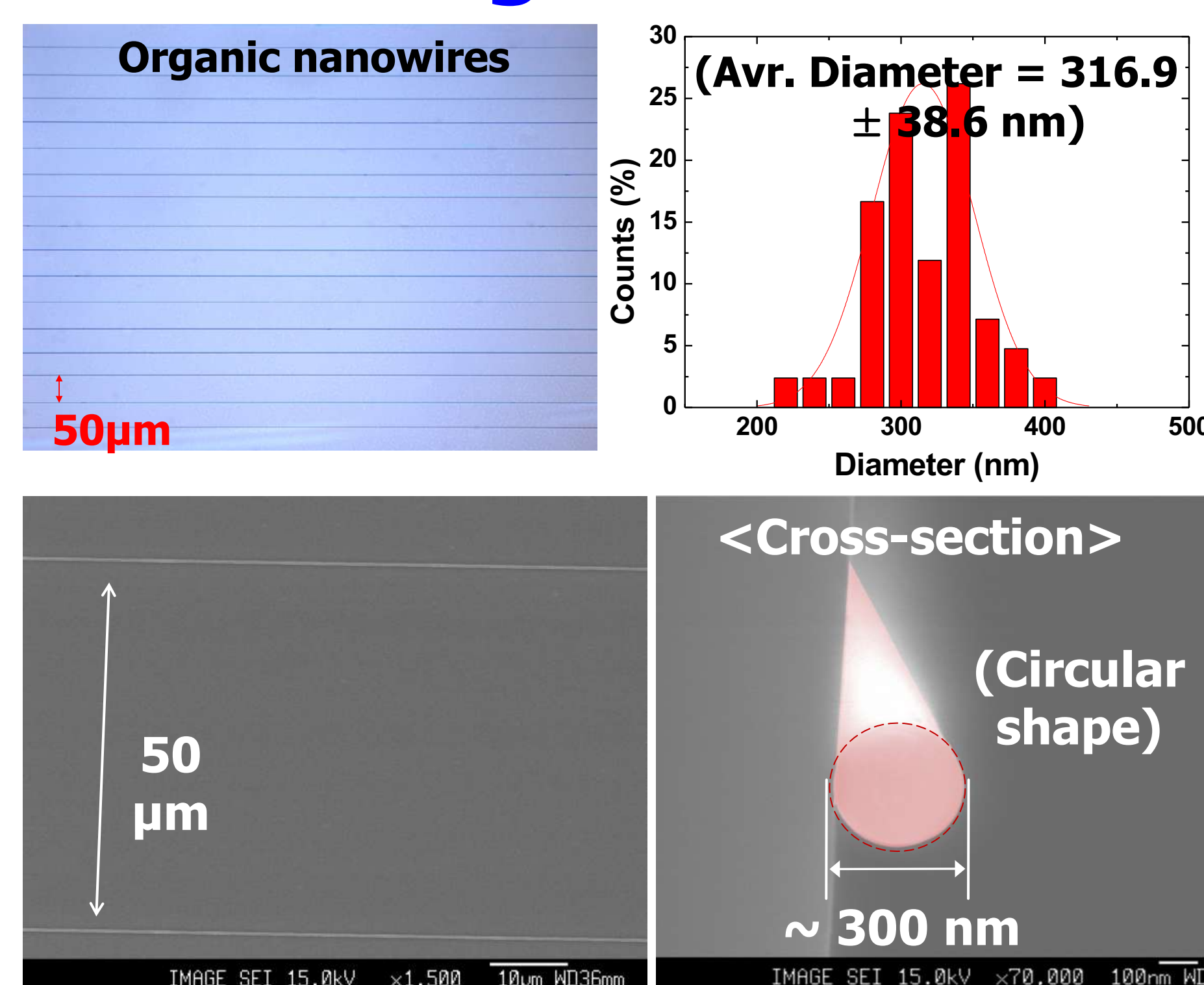
Technology

Electrohydrodynamic Nanowire Printing

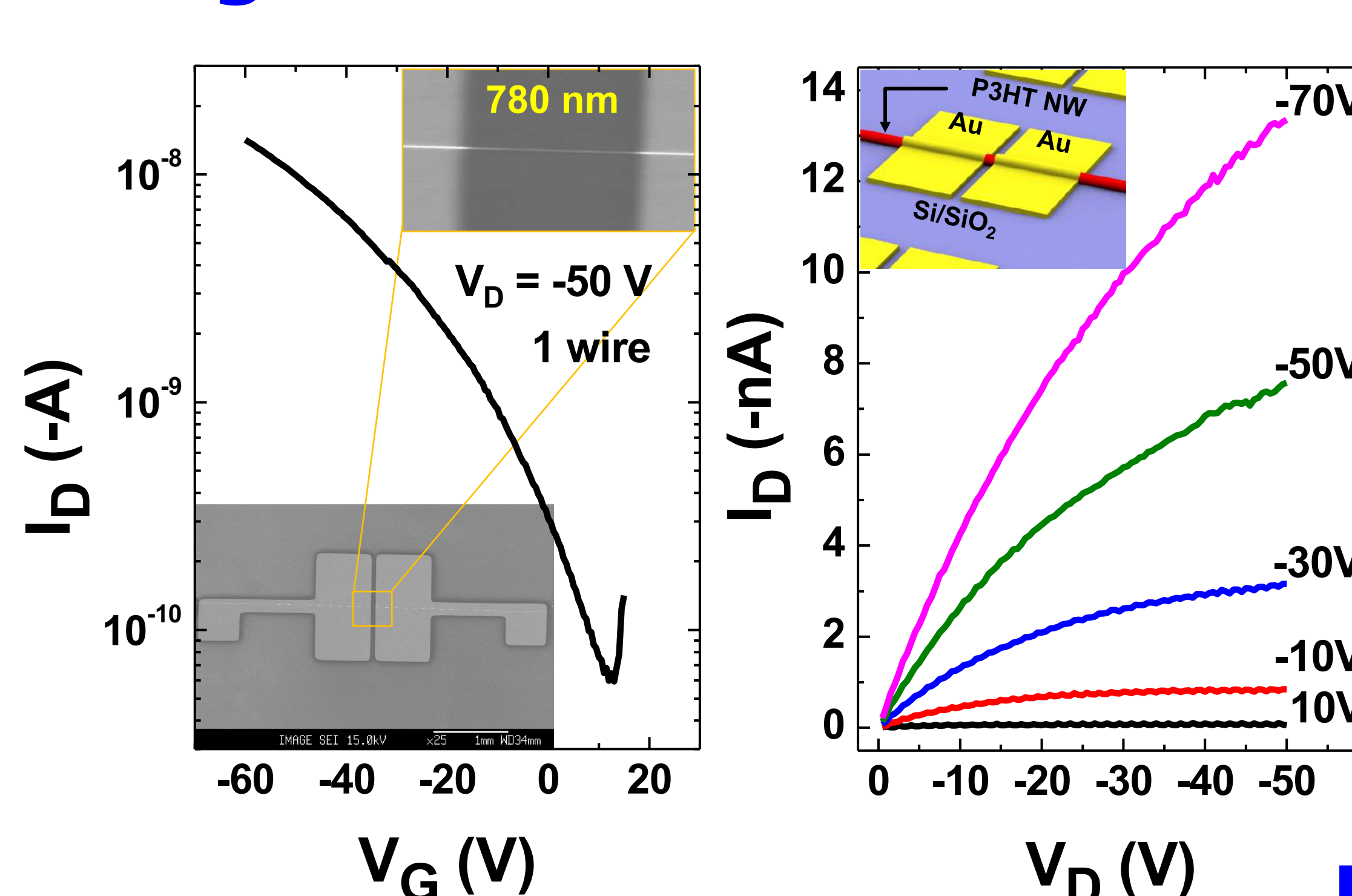


- E-nanowire printing can adjust the distance between the nozzle and the collector in a very close range, and the high-speed robot stage moves the collector, thereby forming aligned high-resolution organic nanowire array patterns.
- Using high-resolution aligned organic wire patterns, nanodevices such as nanowire transistors and high-sensitivity biosensors can be fabricated.

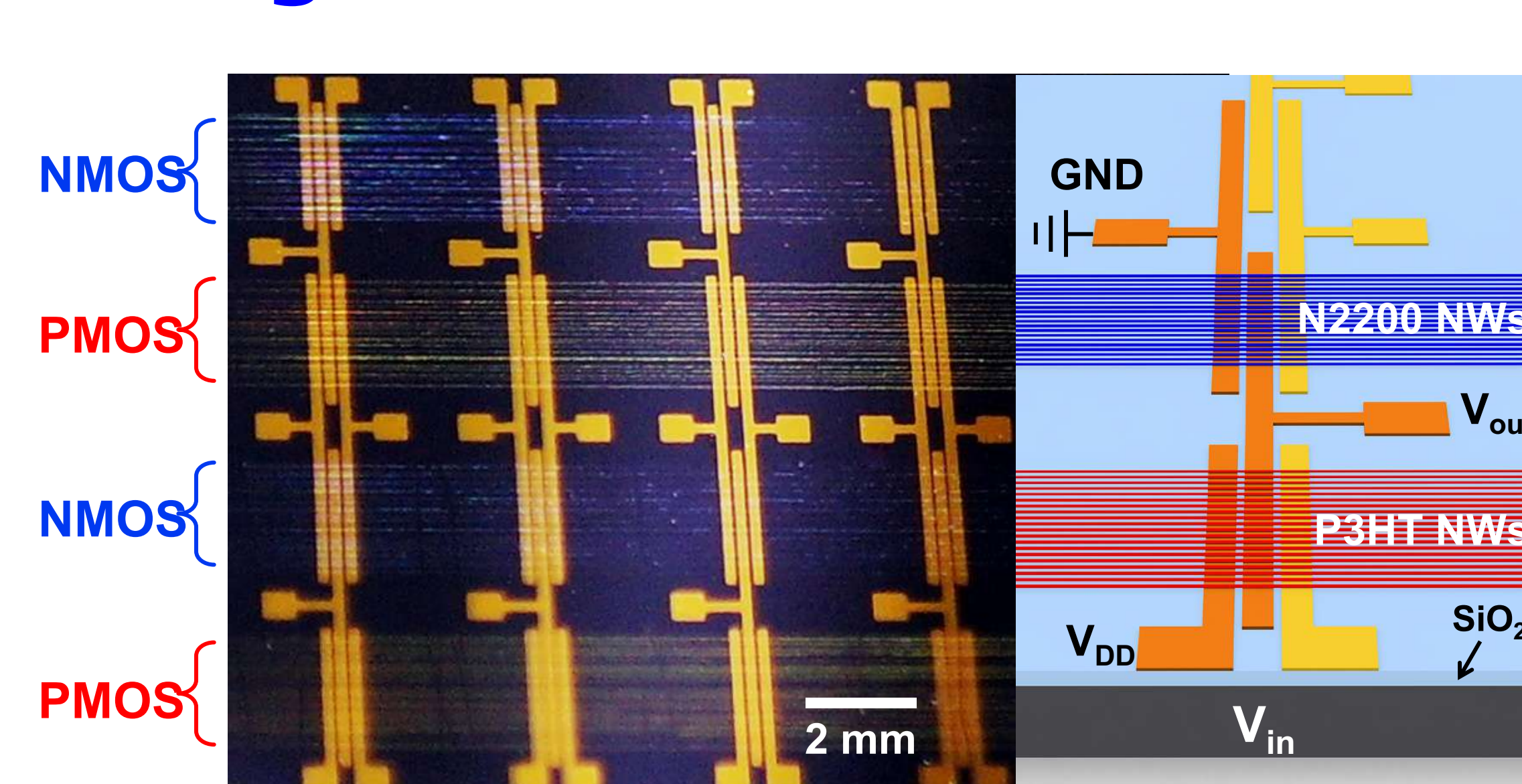
Printed organic nanowires



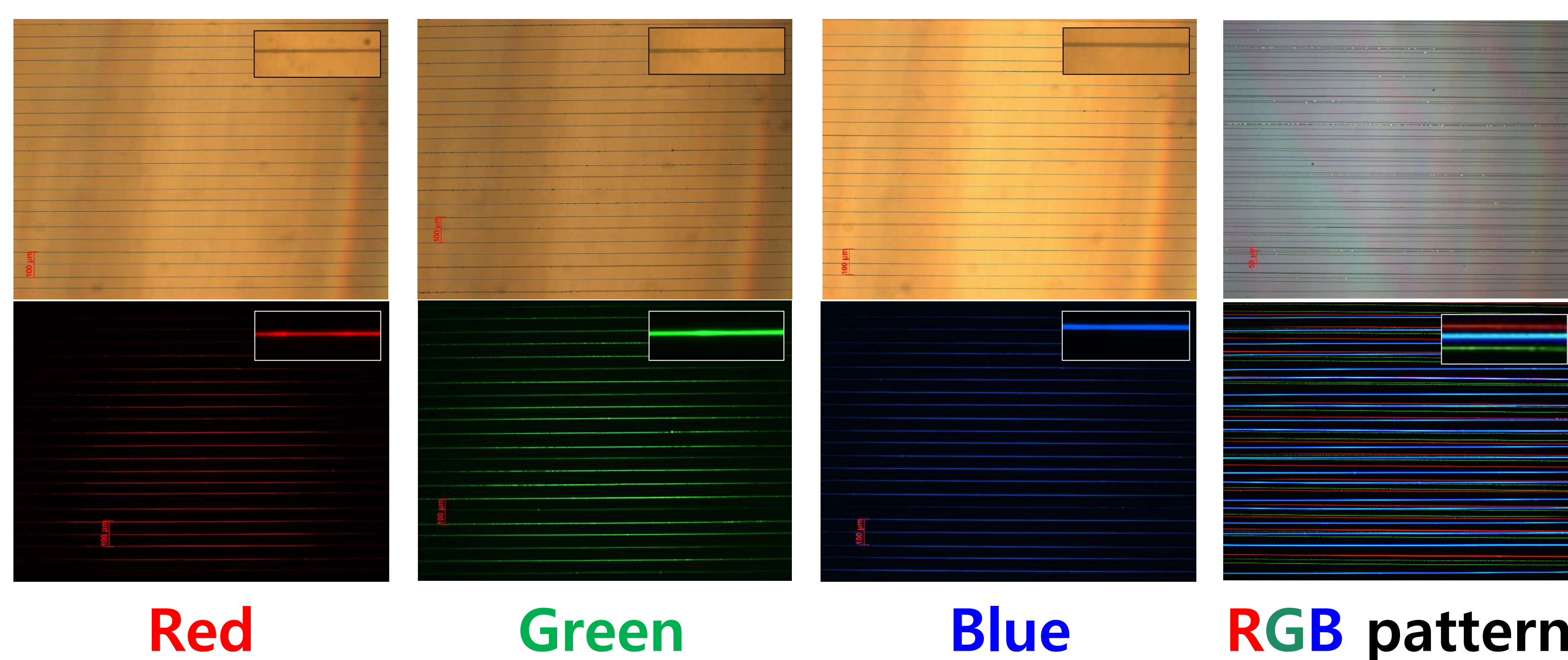
Organic nanowire transistors



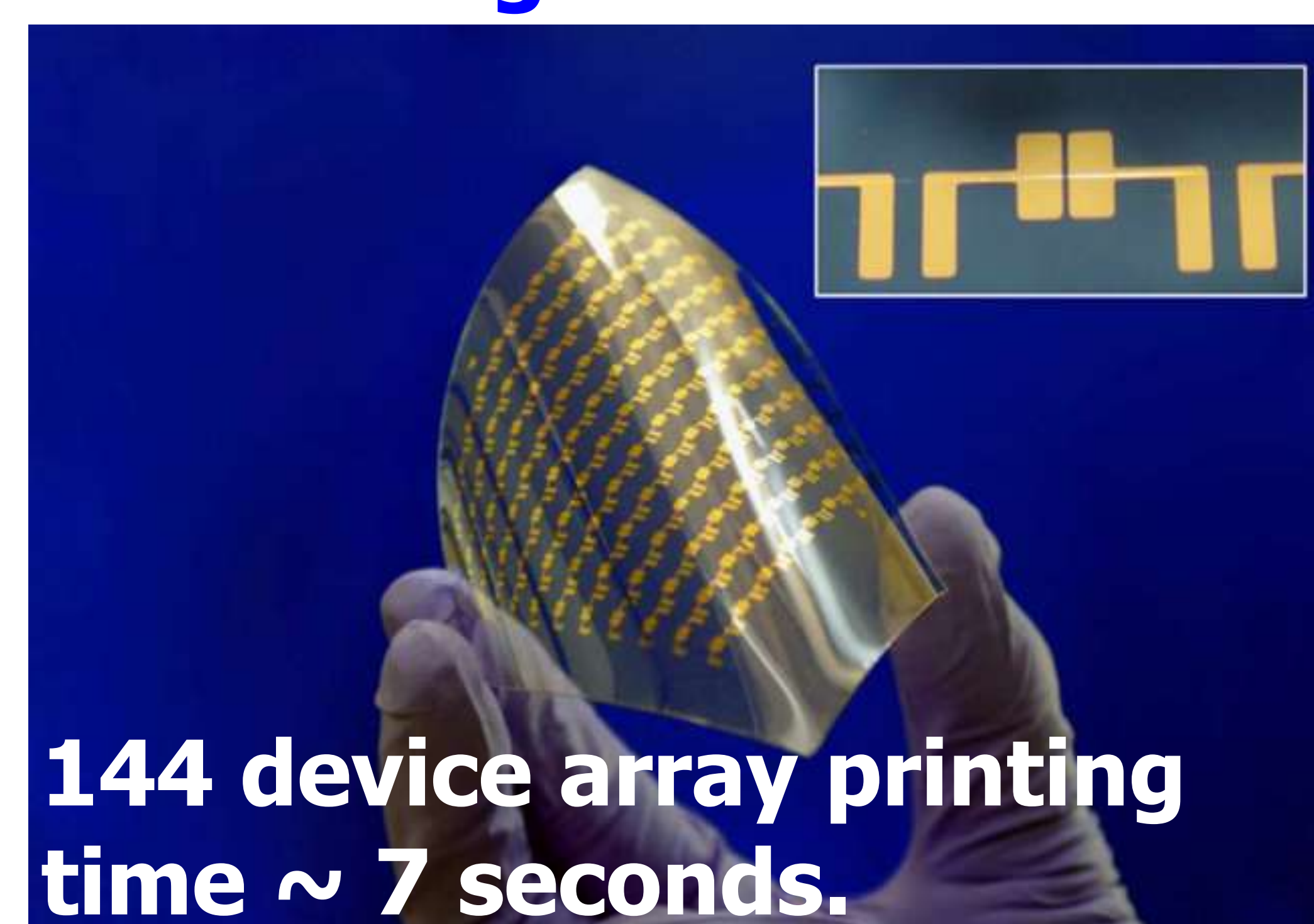
Organic nanowire inverters



Light-emitting organic nanowires



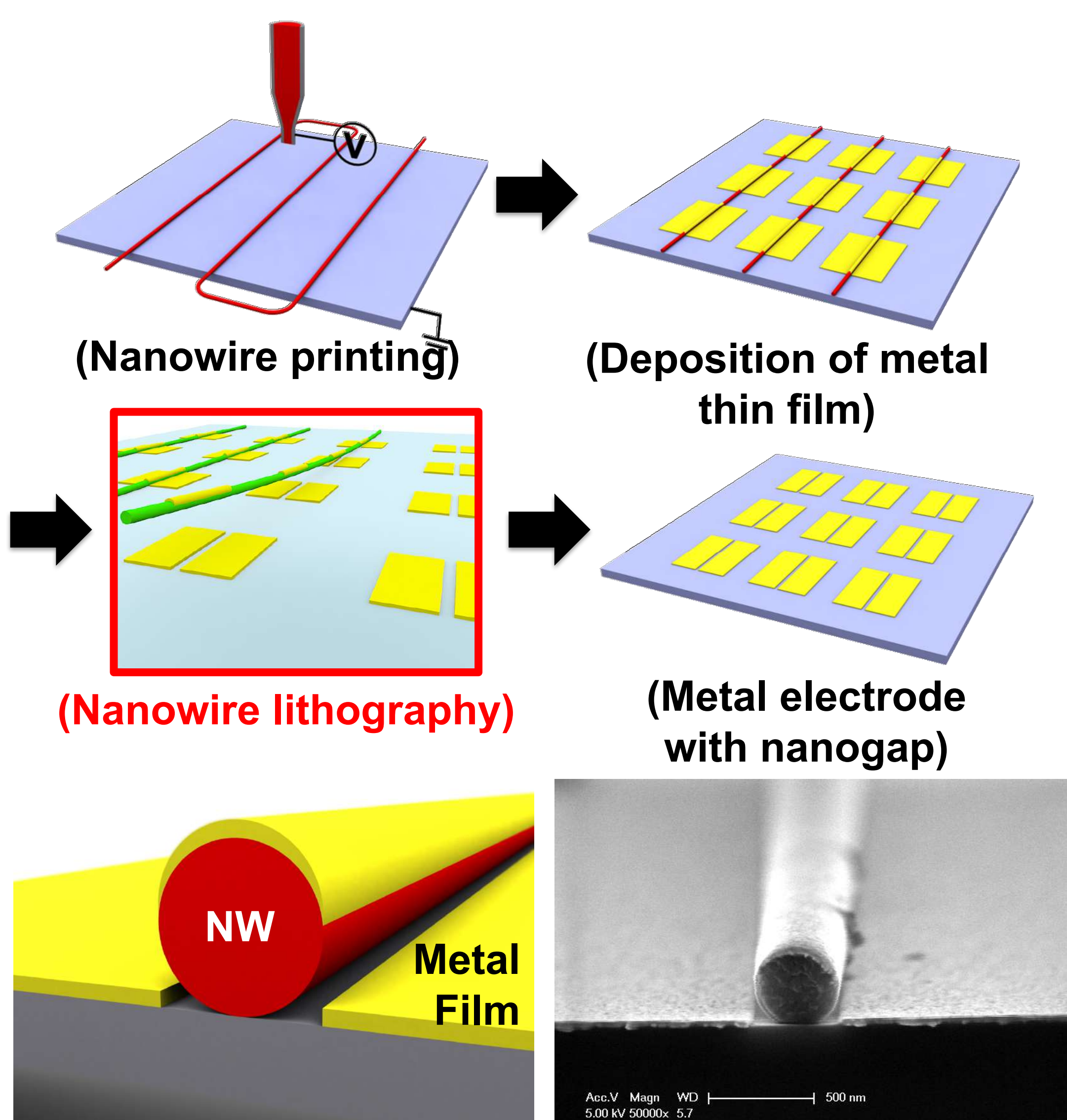
High speed printing of large-scale organic nanowires



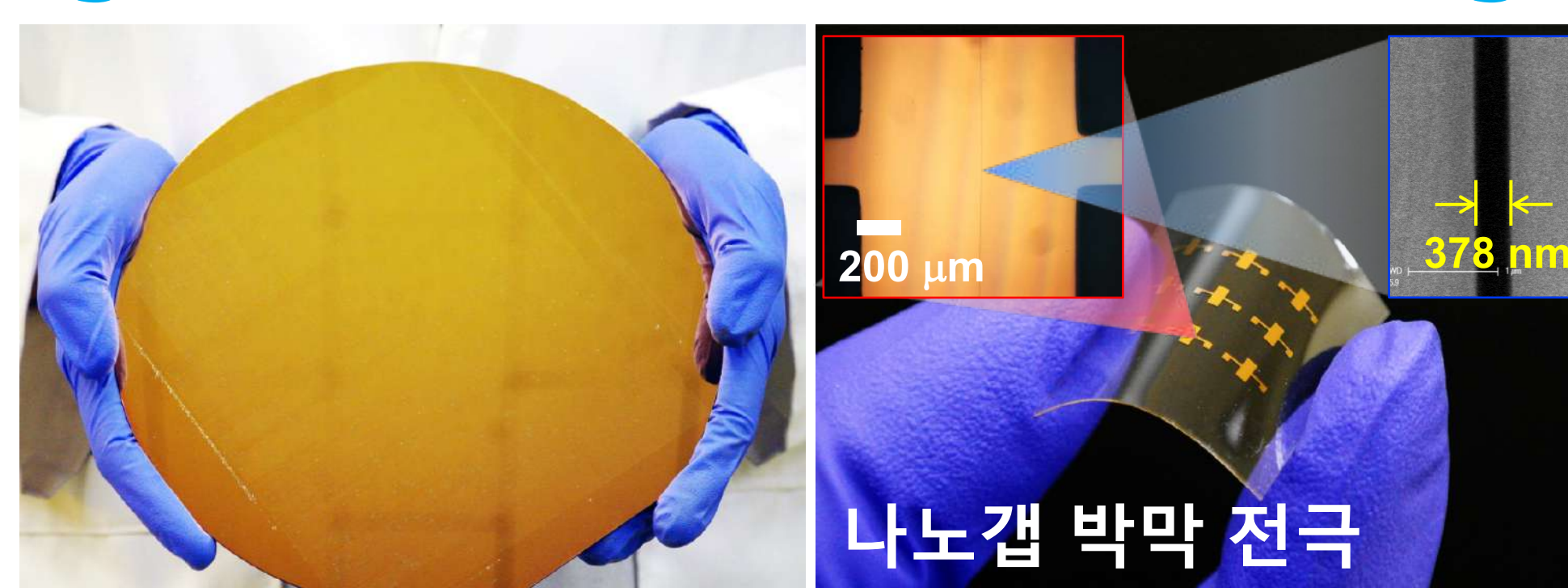
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Advantages and Prospect

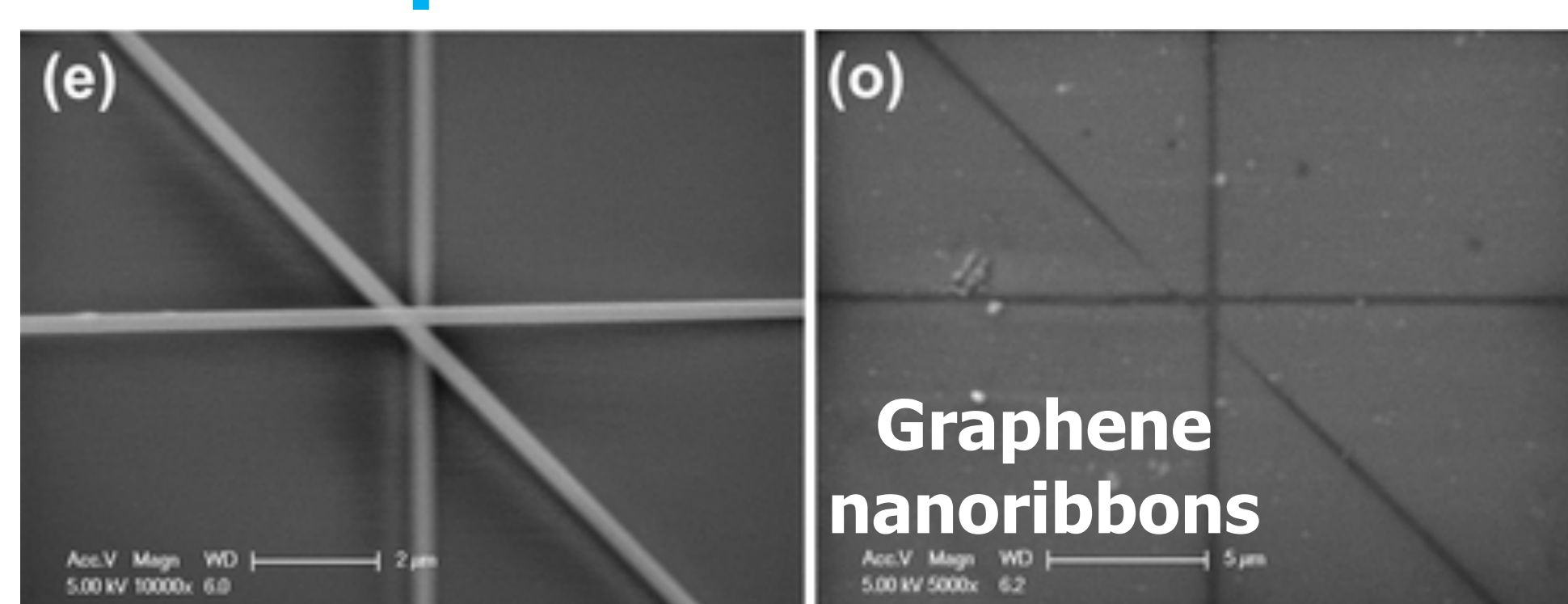
Organic nanowire lithography



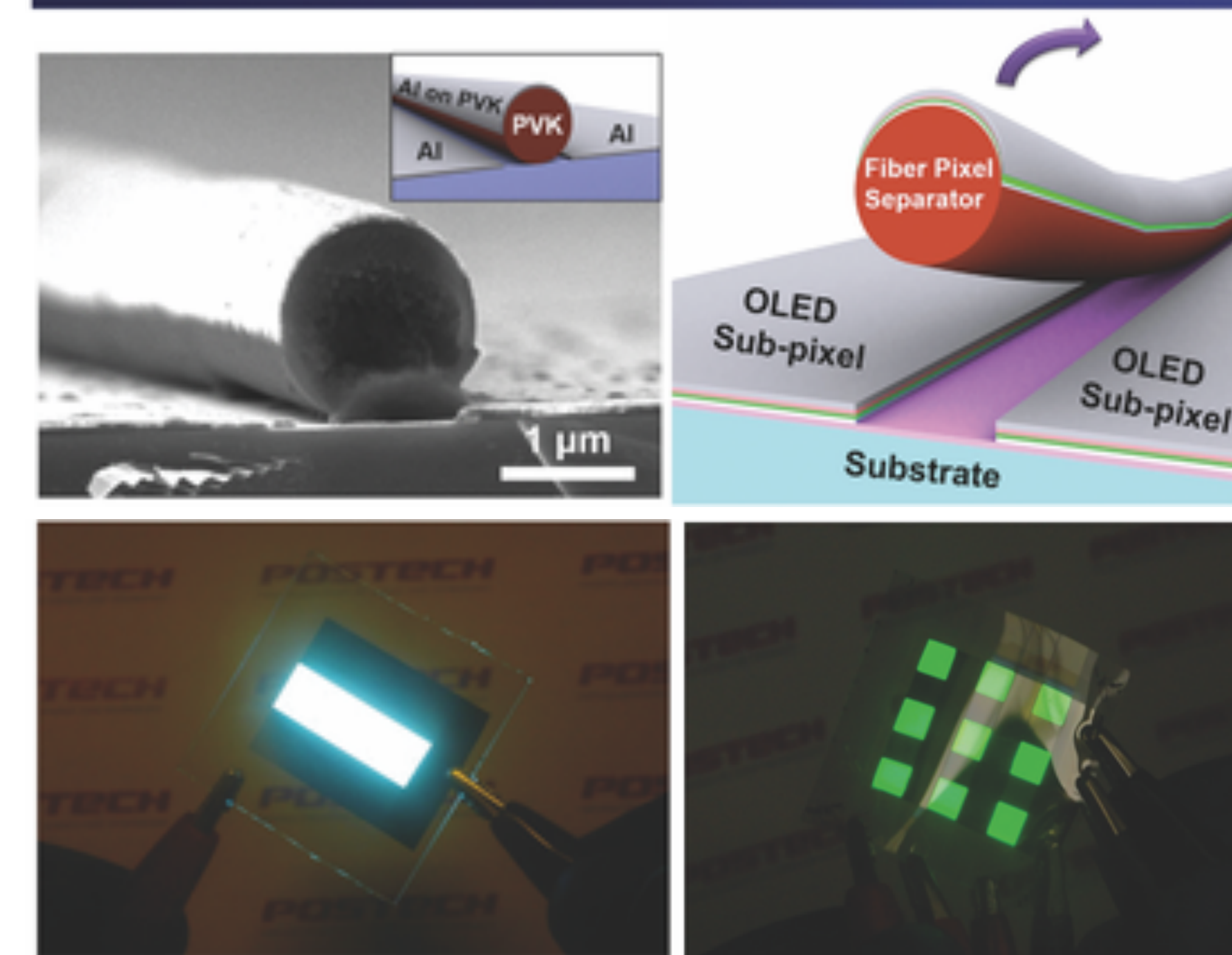
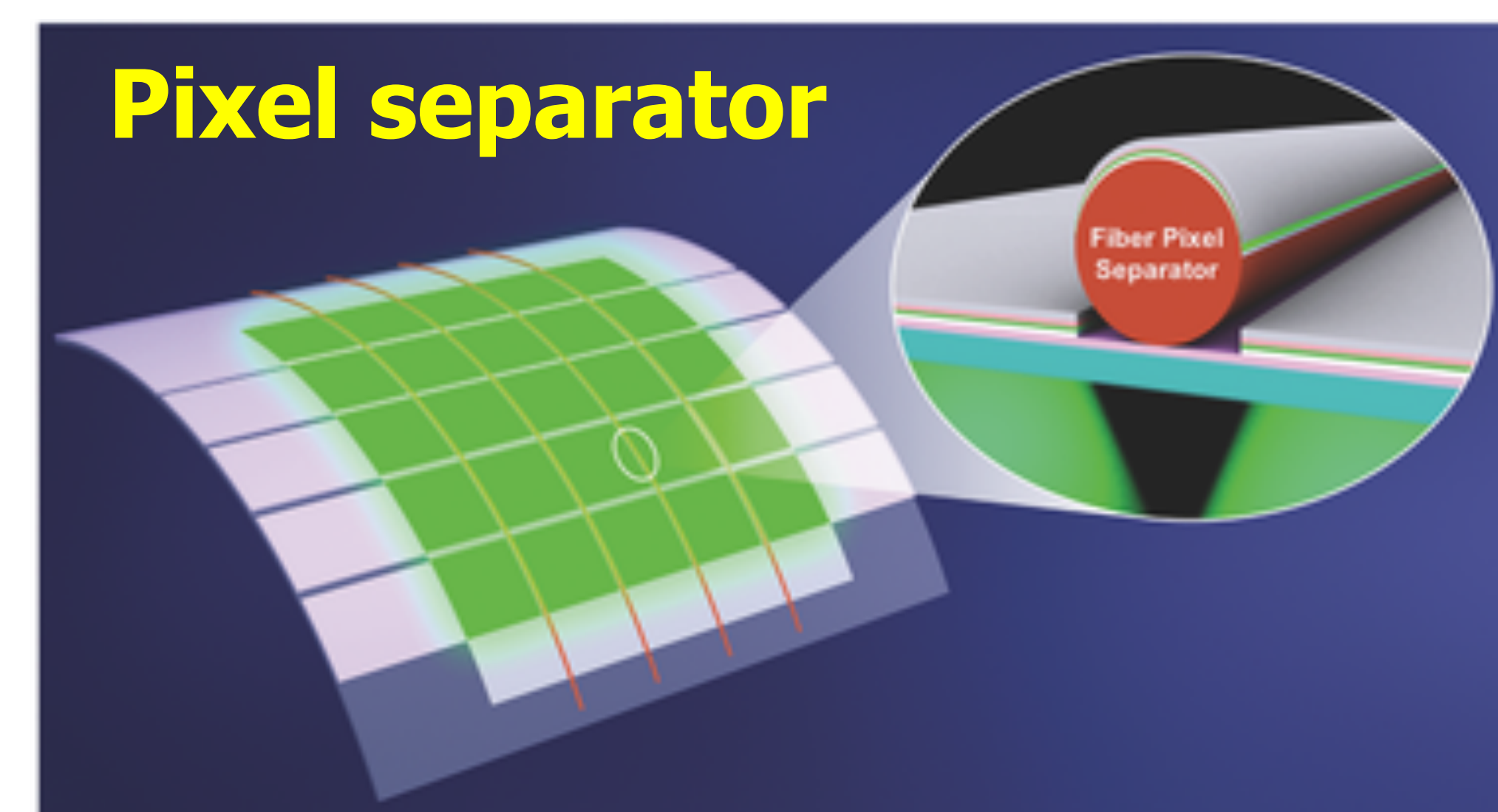
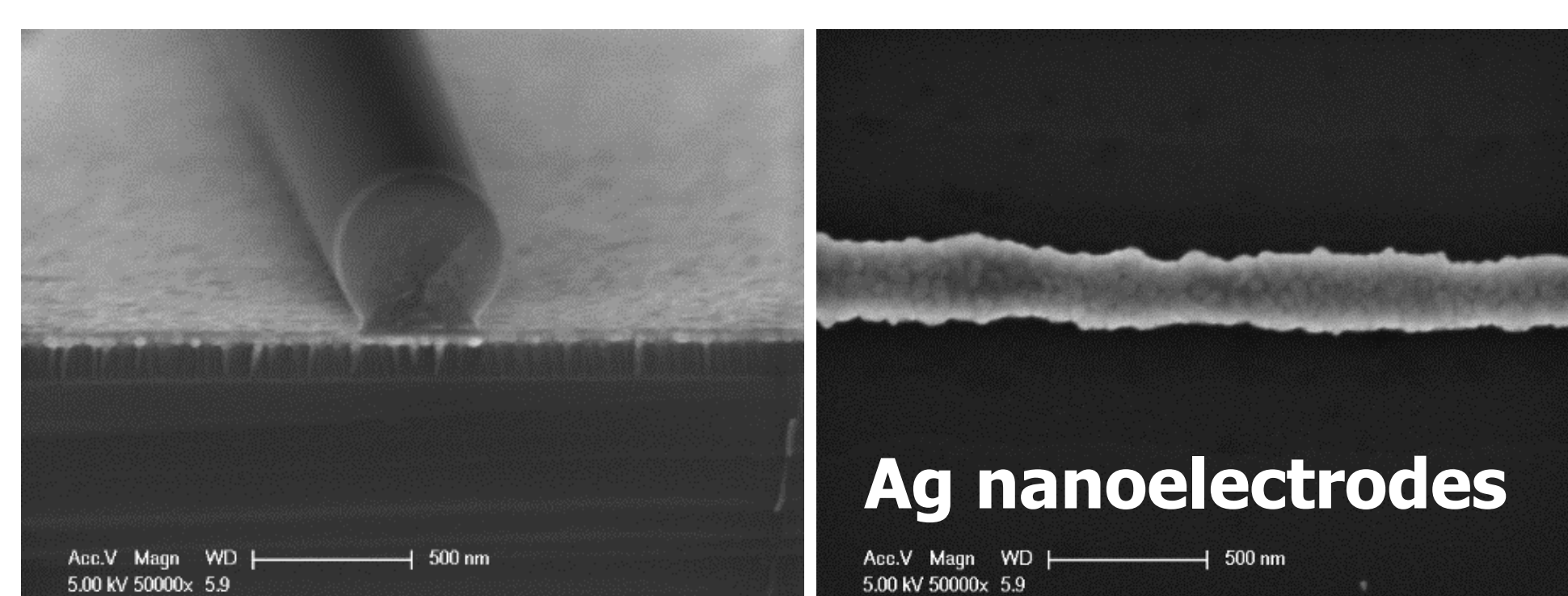
Large-area electrodes with nanogap



Graphene nanoribbons



Metal nanoelectrodes



- Organic semiconductor nanowire alignment technology using E-nanowire printing system is a very unique and new fabrication technology of organic electronic devices.
- It is possible to precisely control the number of wires while controlling the regular spacing of the organic nanowires within a few micrometers.
- It will be the first breakthrough to solve the problems of large area patterning and high-speed alignment of organic nanowires, which are the main obstacles of organic nanowire electronics.
- Large-area alignment of nanomaterials will allow large-scale array of various nanomaterials such as graphene, quantum dot, and organic-inorganic hybrid nanowires to be used to realize large-area soft nanoelectronics.

Patents

- Electric field aided robotic nozzle printer and method for fabrication of organic nano structure (Domestic registration : 10-1374401, PCT/KR2011/007411, US 13/877806, JP 2013-532728, CN 201180048515, DE 11 2011 103 398.2)
- Method for formation of micro- and nano-scale patterns and method for producing micro- and nano-scale channel transistor, and micro- and nano-scale channel light emitting transistor using the same (Domestic registration : 10-1407209, PCT/KR2011/007413, US 13/877875, JP 2013-532729, DE 11 2011 103 397.4, CN 201180059052)
- Method for Fabrication of Electrospun Polystyrene Nanofiber and Method for Fabrication of Electrospun Polystyrene-Quantum Dot Hybrid Nanofiber Using Styrene Monomer (Domestic registration : 10-1336251)
- Laser Device Including Aligned Light-Emitting Organic Nanowire and Method for Fabricating The Same (Domestic registration : 10-1343013)
- Color-Conversion Phosphor Layers including Aligned Light-Emitting Organic Nanofibers and their Fabrication Process (Domestic registration: 10-1436990)
- Device imitating synaptic and method of manufacturing thereof (Domestic application: 10-2014-0104279, PCT/KR2014/012656)



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Papers

- Large-scale organic nanowire lithography and electronics, *Nature Commun.*, 2013, 4, 1773.
- Rapid Fabrication of Designable Large-Scale-Aligned Graphene Nanoribbons by Electrohydrodynamic Nanowire Lithograph, *Advanced Materials*, 2014, 26, 21, 3459.
- Organic core-sheath nanowire artificial synapses with femtojoule energy consumption, *Science Advances*, 2016, 2, e1501326.
- Scalable Non-Invasive Organic Fiber Lithography for Large-Area Optoelectronics, *Advanced Optical Materials*, 2016, 4, 967.

Applications

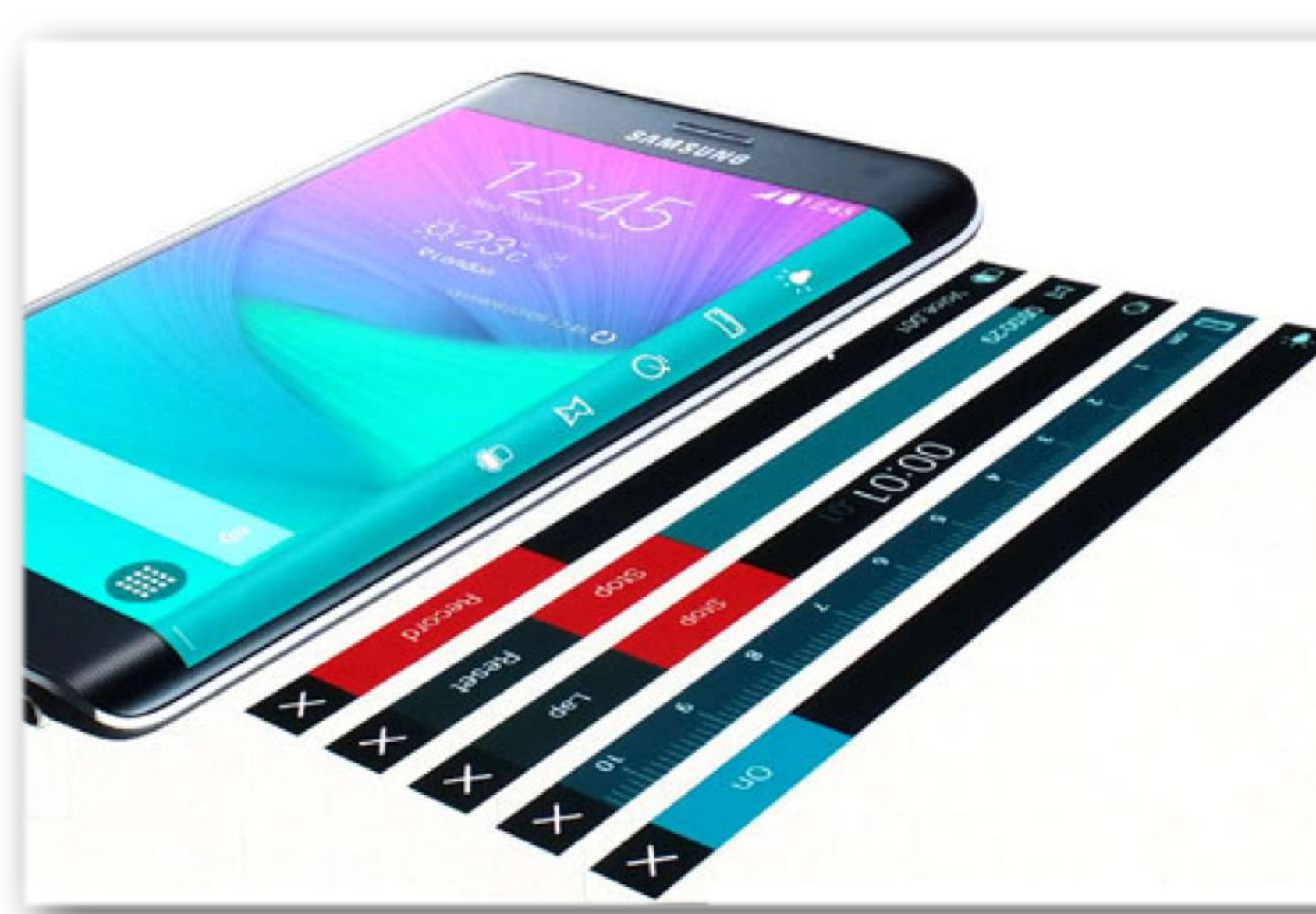
Curved TV



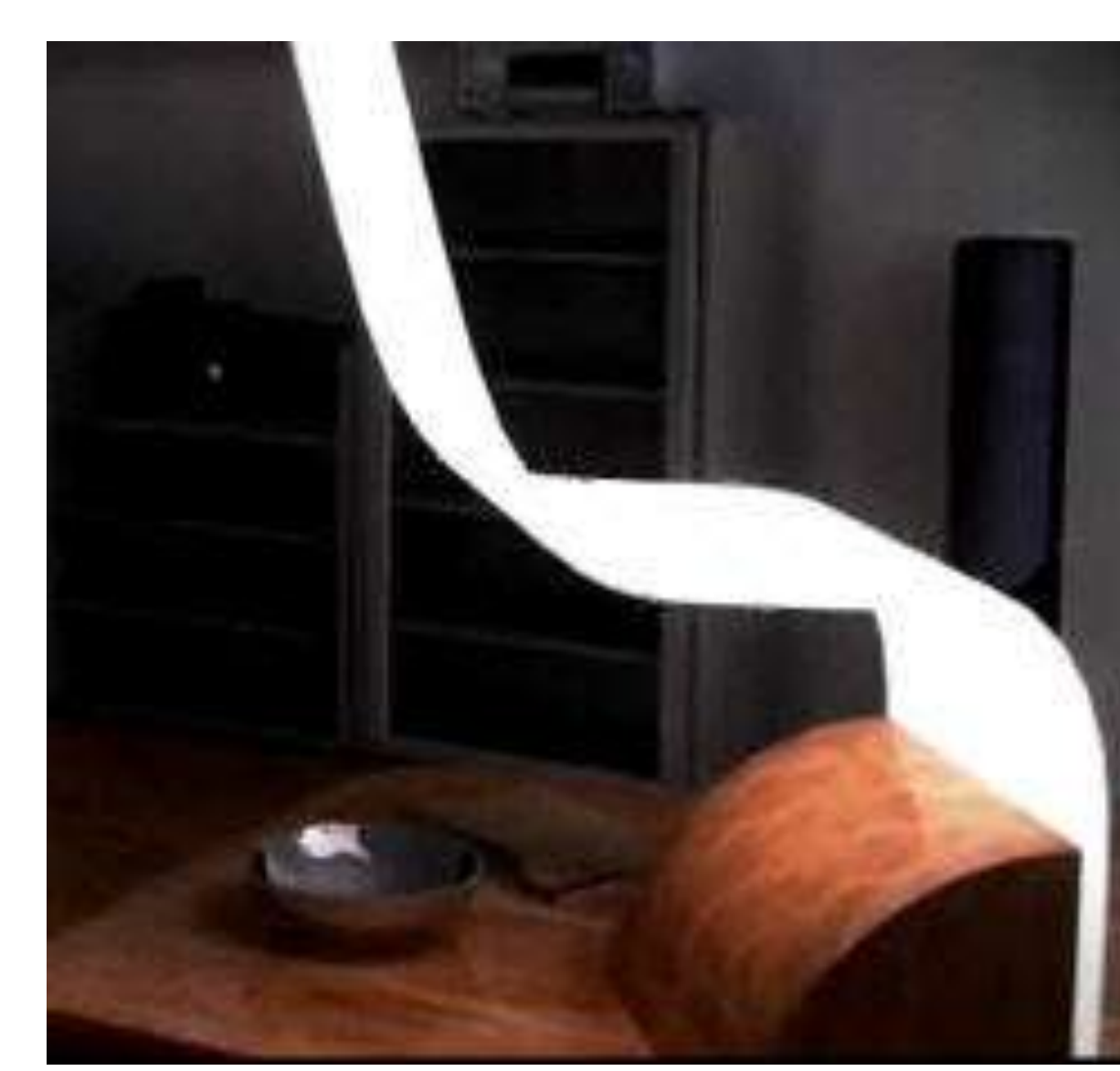
Digital screens and billboards



Smart phones



Flexible lighting



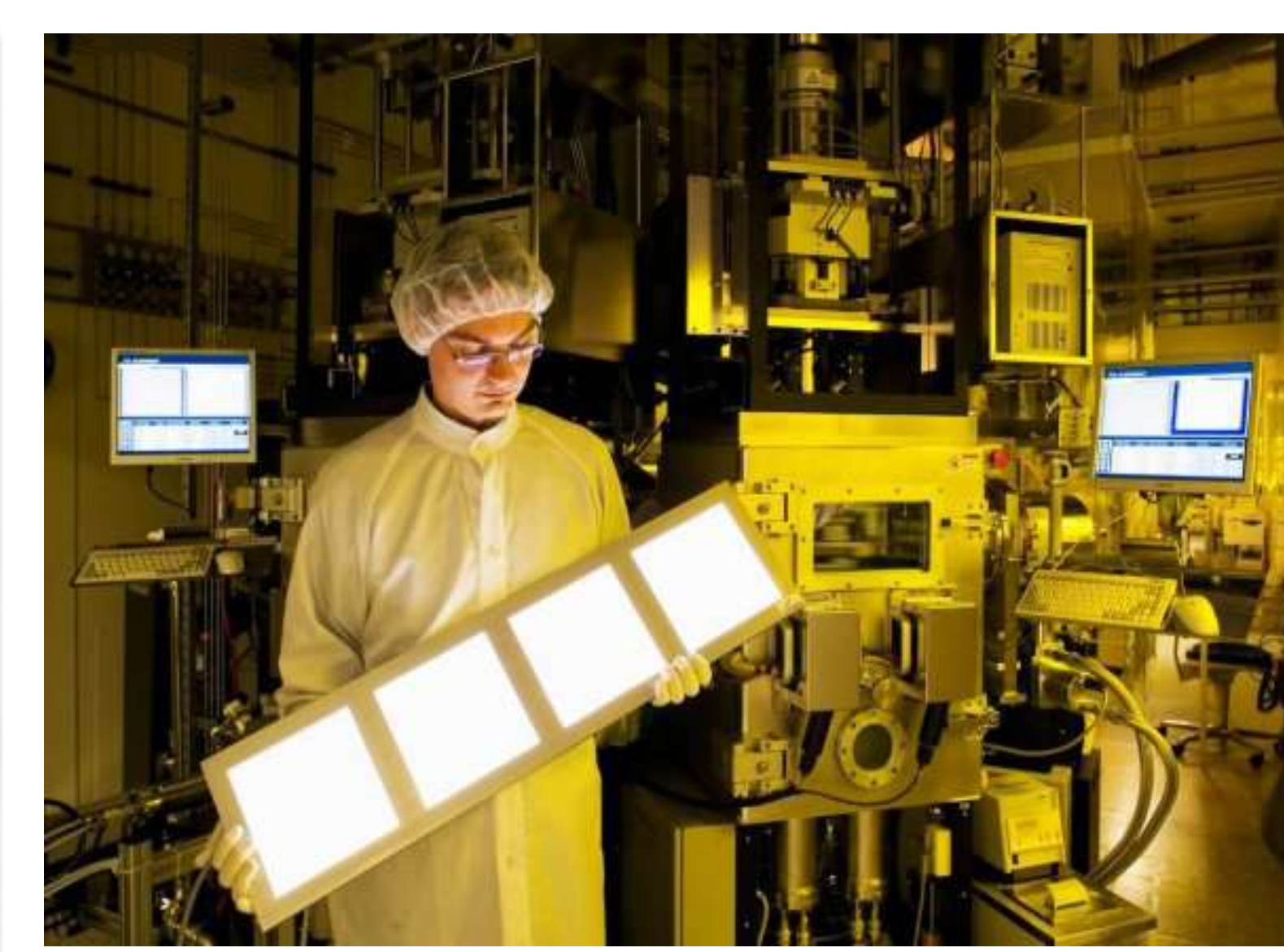
Automobile displays



Flexible displays



Laser



Illumination

Related Company

- Display company
- Lighting company
- Light-emitting film company

Source Technology

- We initially registered the 13 granted core-patents in Korea and applied them in other countries.
- We have published several related patents in Korea and other countries.