

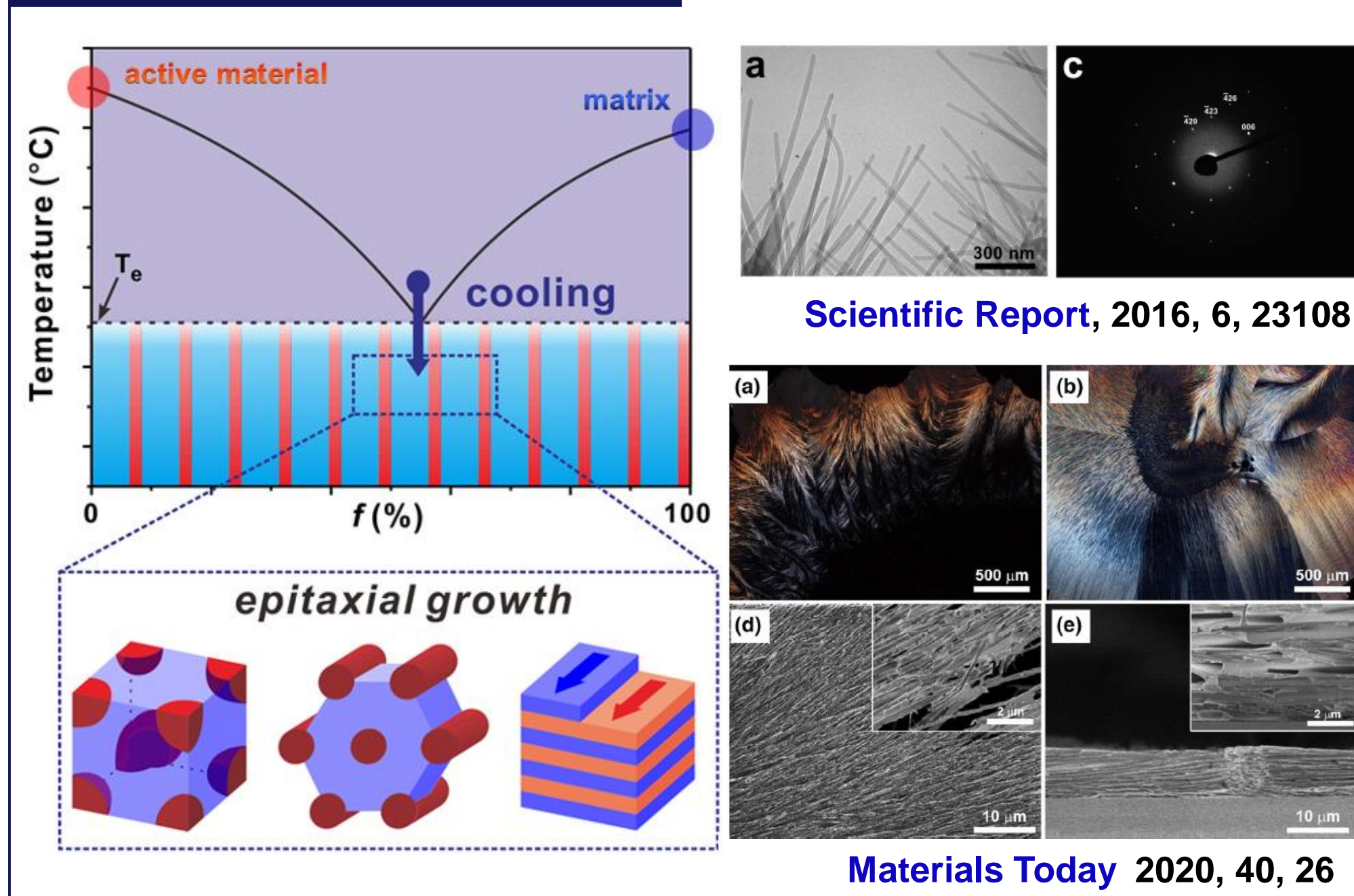
A Facile Method for Fabricating Highly Crystalline Semiconducting Polymers by Using Eutectic Friction Transfer Lithography

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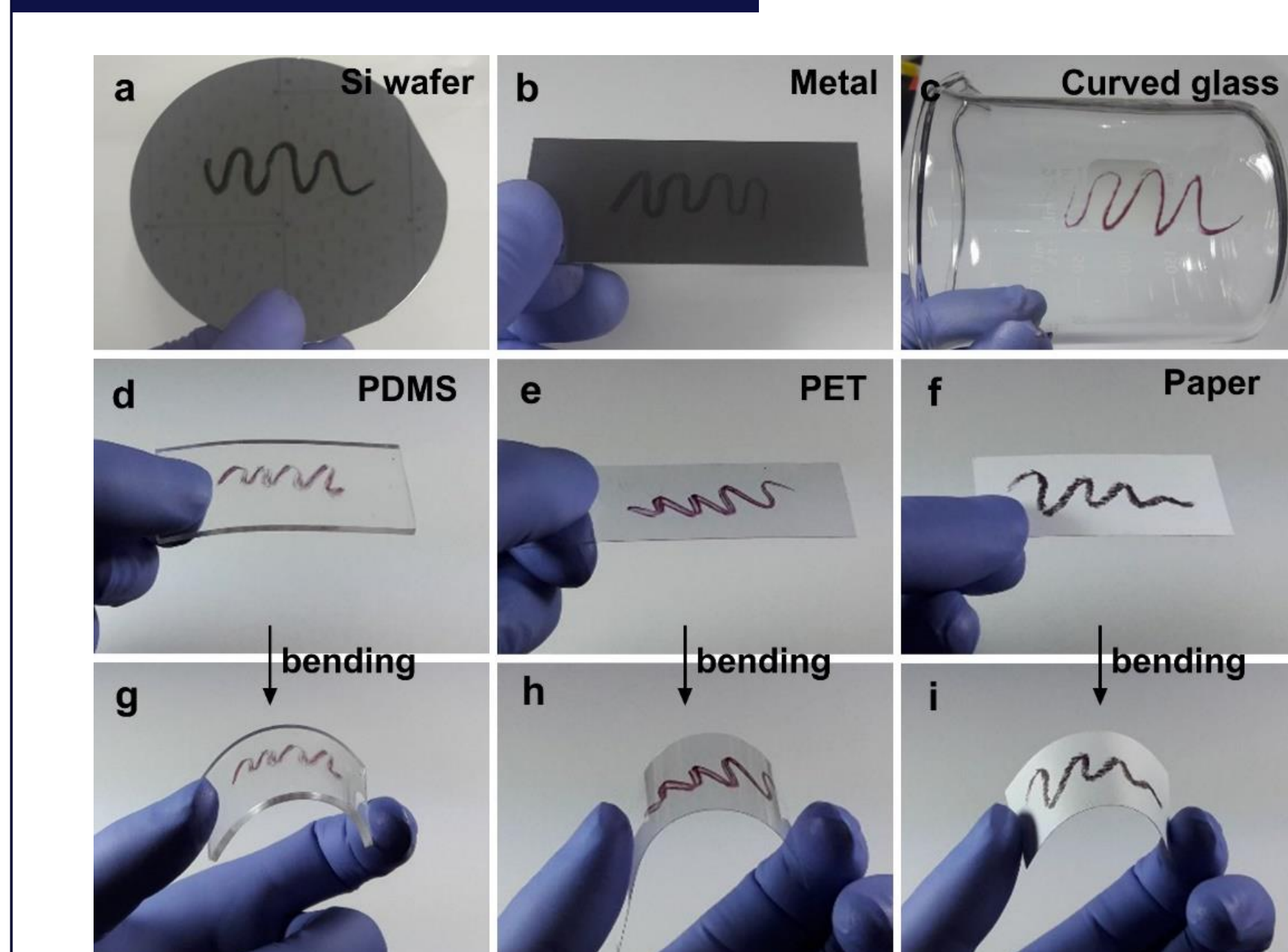
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Eutectic System



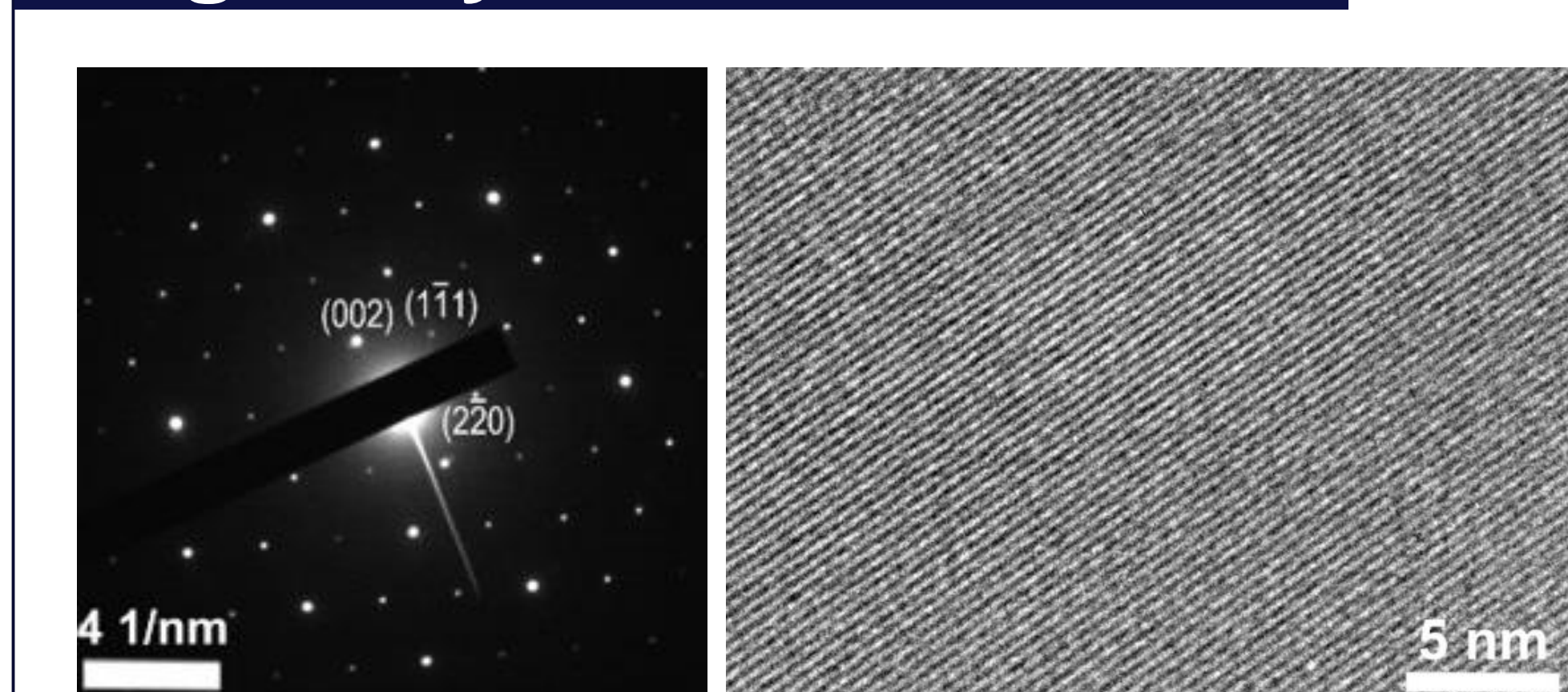
Eutectic systems can be used to produce the micro- or nanostructures by using the eutectic reaction, a phase transition between liquid and mixture of solid phases.

Various Substrate



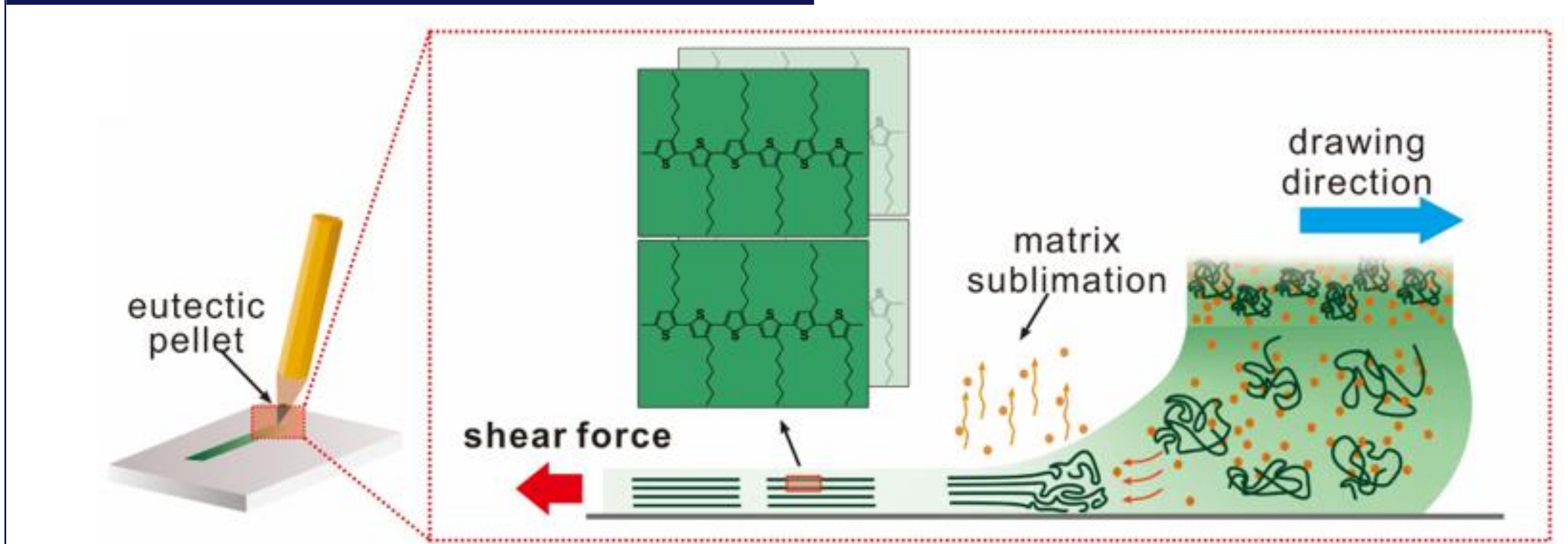
EFT films on various substrates including (a) silicon wafer, (b) metal (STS 304), (c) curved glass, (d) PDMS, (e) PET and (f) paper.

Single-Crystal-like Structure



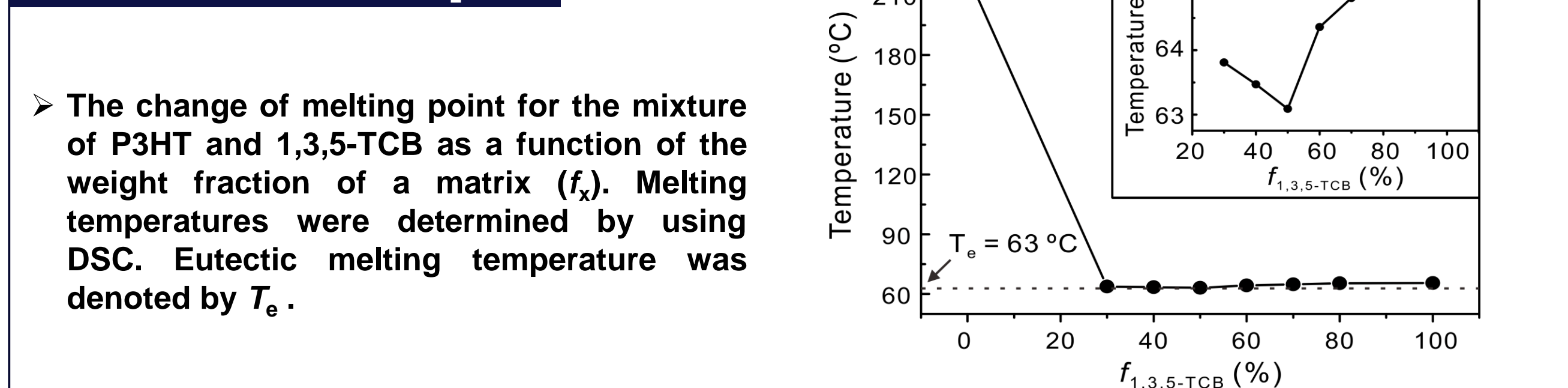
TEM micrograph of P3HT_{EFT} and SAED pattern.

Eutectic Friction Transfer (EFT)



Crystallization scheme of semiconducting polymers by eutectic friction transfer (EFT).

Eutectic Graph



The change of melting point for the mixture of P3HT and 1,3,5-TCB as a function of the weight fraction of a matrix (f_m). Melting temperatures were determined by using DSC. Eutectic melting temperature was denoted by T_e .

Drawing Condition



Optimization of the drawing speed and pressure of EFT process.

Eutectic Pen

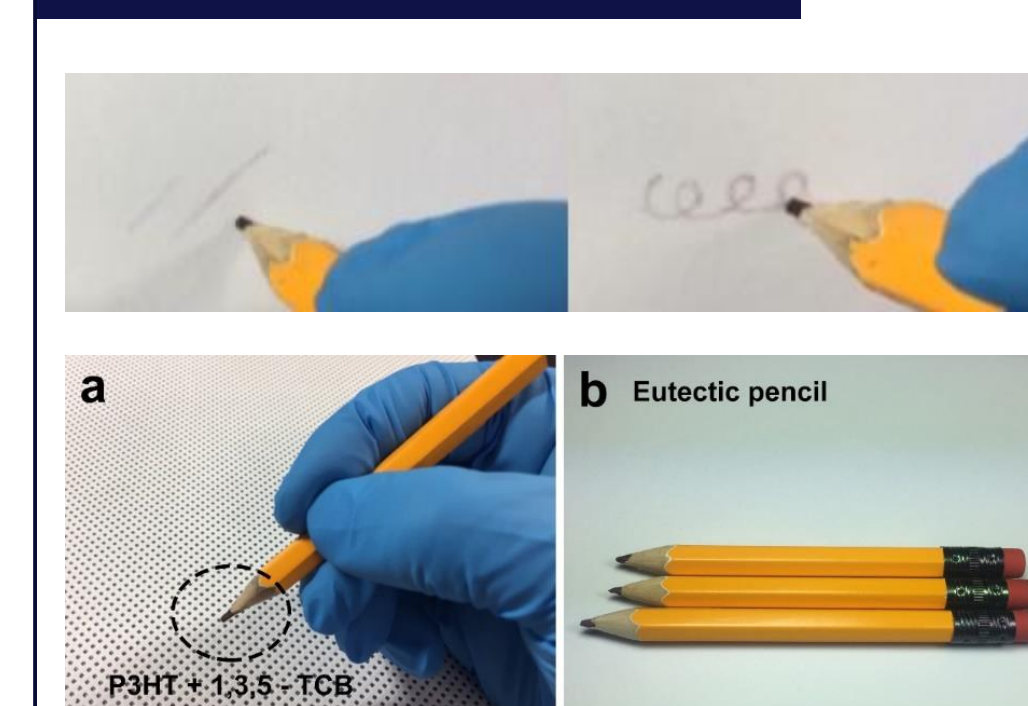
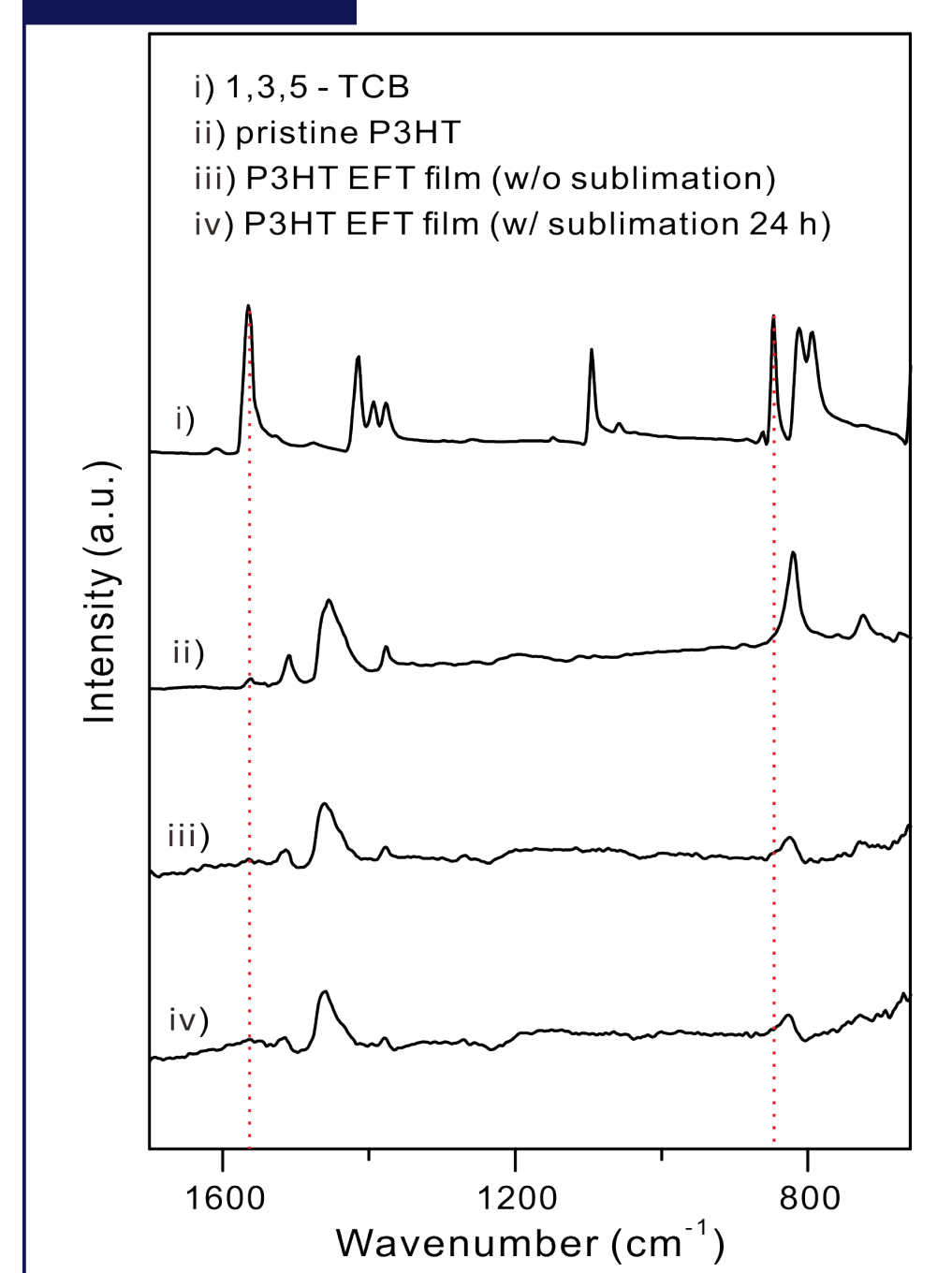


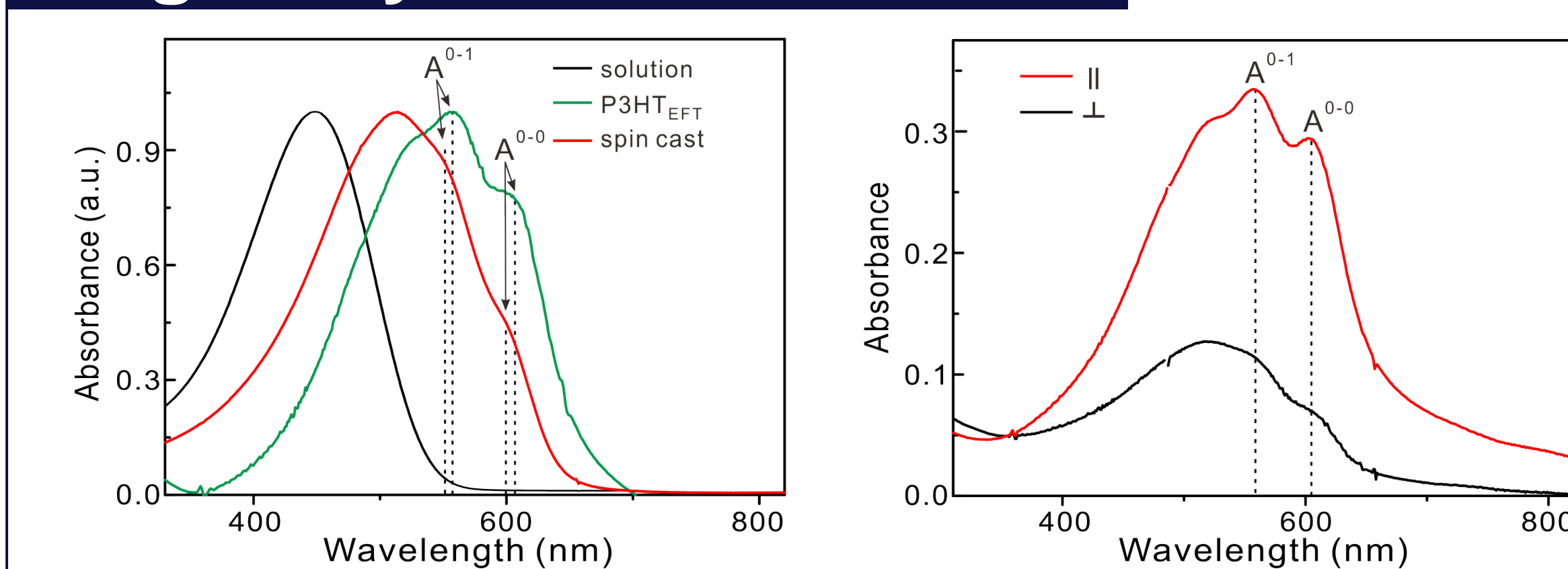
Image of eutectic pen.

FT-IR



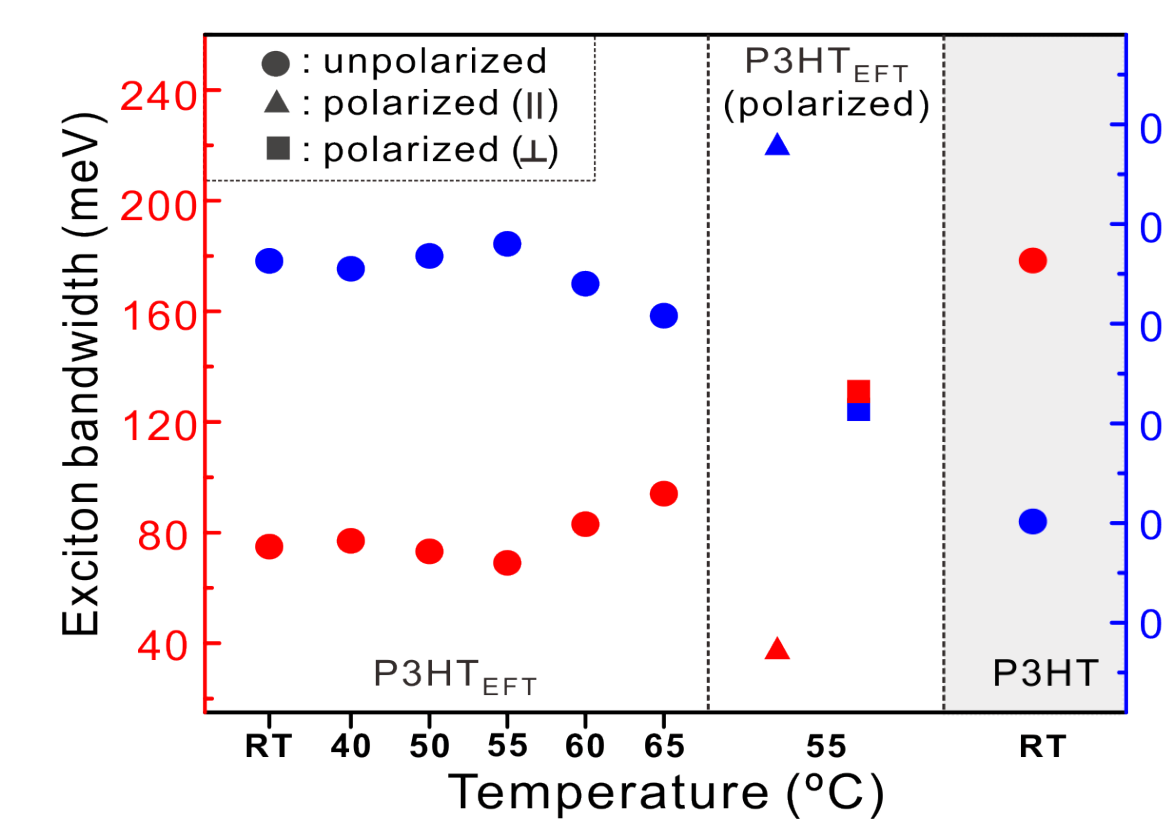
FT-IR spectra. The characteristic C=C stretching peak (1560 cm^{-1}) and C-Cl stretching peak (850 cm^{-1}) of 1,3,5-TCB disappeared right after EFT process.

Single-Crystal-like Structure



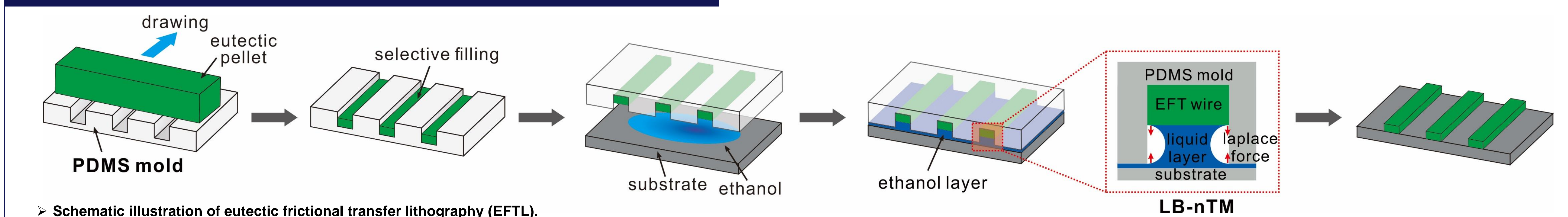
UV-VIS spectra of P3HT_{EFT} film (green line), spin-casted P3HT film (red line) and solution (black line).

Polarized UV-VIS spectra of P3HT_{EFT} film. The red and black solid lines were obtained when polarization is parallel and perpendicular to the drawing direction, respectively.



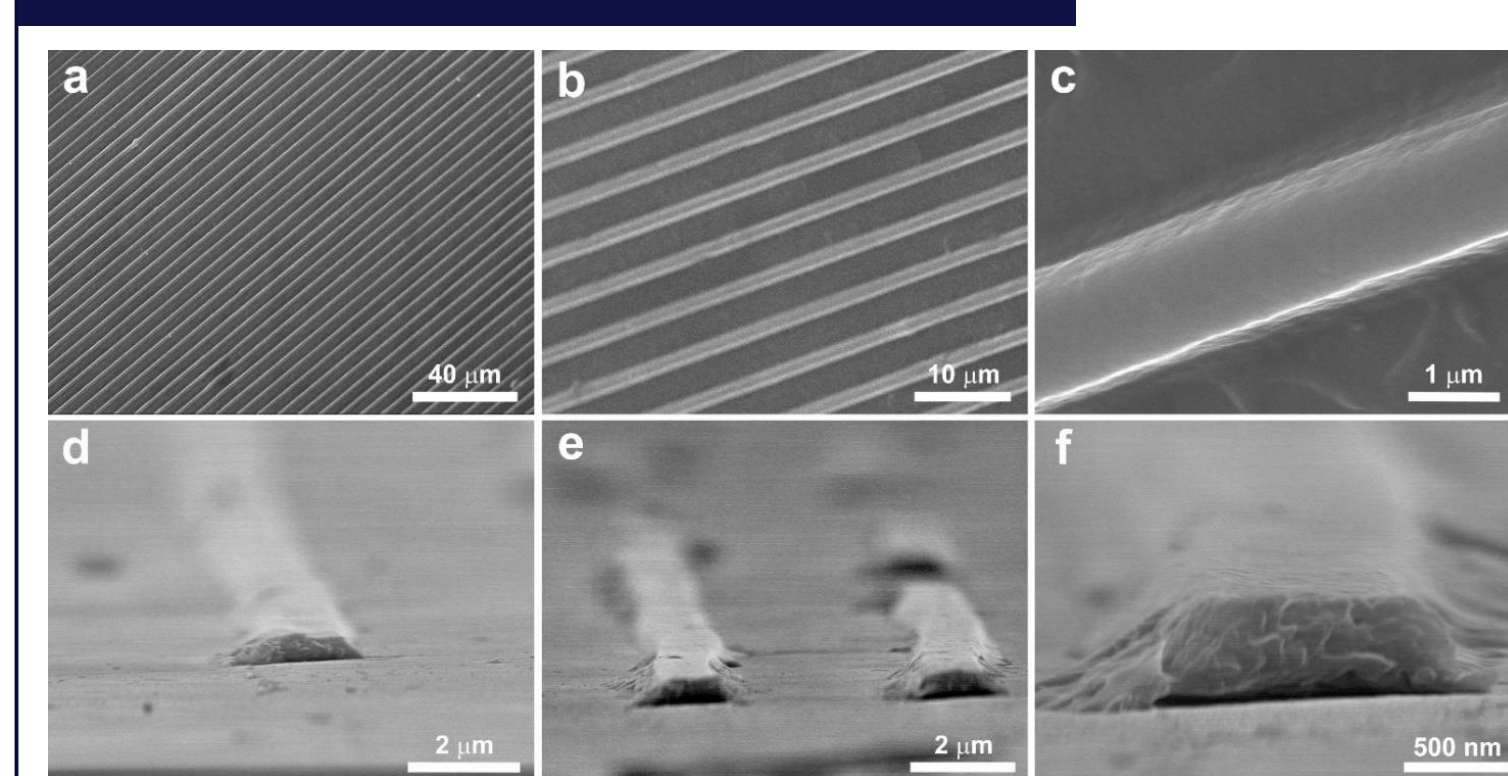
The changes of exciton bandwidth and A^{0-1}/A^{0-0} ratio of P3HT_{EFT} as a function of the substrate temperature. P3HT_{EFT} and spin-casted P3HT films were prepared at 55 °C and room temperature, respectively.

Eutectic Friction Transfer Lithography (EFTL)



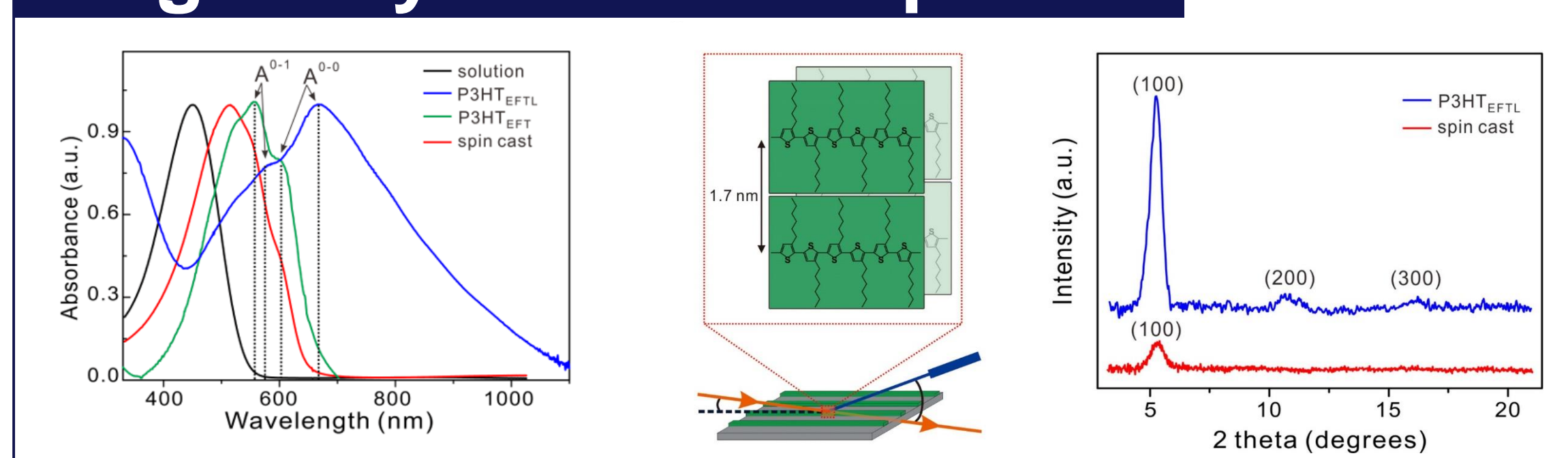
Schematic illustration of eutectic frictional transfer lithography (EFTL).

EFTL Micro Wires

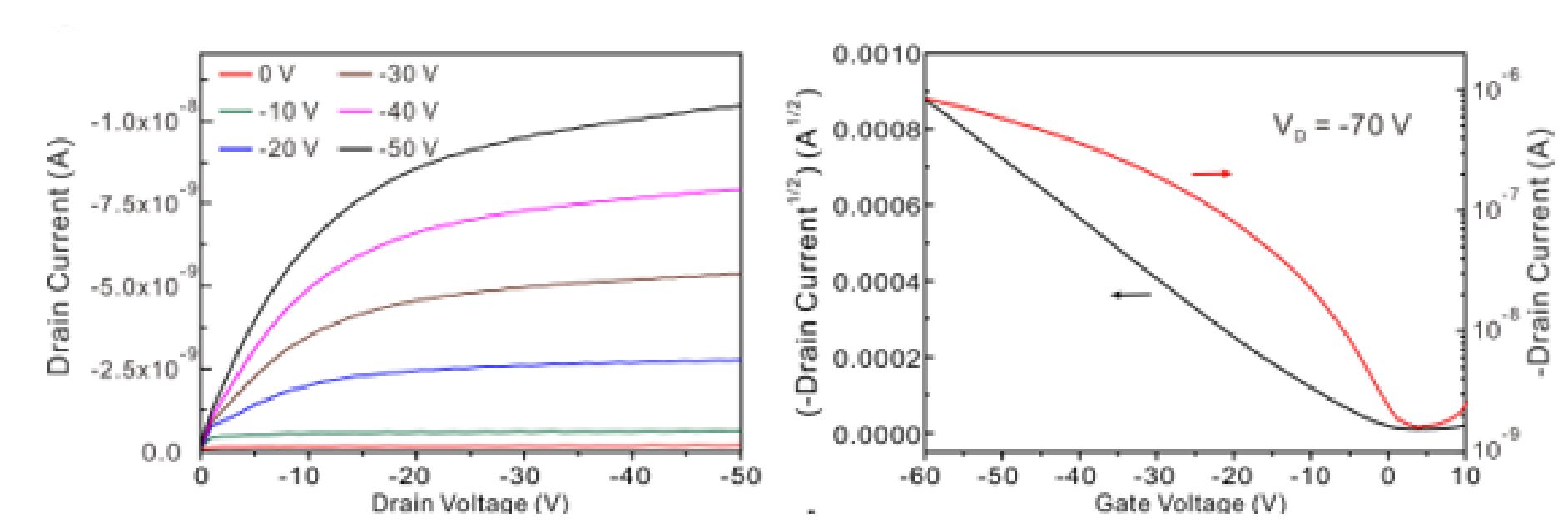


SEM micrographs of P3HT_{EFTL}.

Single-Crystal-like Properties



UV-VIS spectra of (a) P3HT_{EFTL}. Scheme of GIXRD measurement, GIXRD profile of P3HT_{EFTL} (blue line) and spin casted film (red line). X-ray intensity was normalized with the sample volume.



Electrical properties of P3HT_{EFTL}. Output curves of P3HT_{EFTL}. Transfer curve of P3HT_{EFTL}. Saturation mobility of P3HT_{EFTL} was 0.35 $\text{cm}^2\text{V}^{-1}\text{s}^{-1}$.

Conclusion

- We develop eutectic friction transfer (EFT) method.
- EFT films have high crystallinity like single-crystal.
- EFT films have high electrical properties.
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