

Formation of high performance and functional organic thin films

Keywords: molecular orientation control, flow-coating, photo-alignment, OFETs

Kenji SAKAMOTO

Center for Functional Sensor & Actuator / Molecular Design and Function Group

SAKAMOTO.Kenji@nims.go.jp | <http://www.nims.go.jp/eng/research/group/molecular-design/index.html>



Background

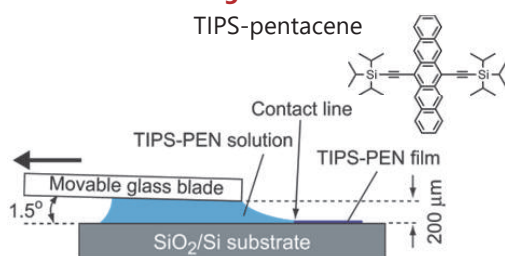
- Organic semiconductor is attracting worldwide attention as the third semiconductor following silicon and compound semiconductors.
- Low-cost, lightweight, flexibility, and low-temperature / large-area processability.
- Application to wearable devices, smart cards, information tags, flexible sheet displays.

Aim

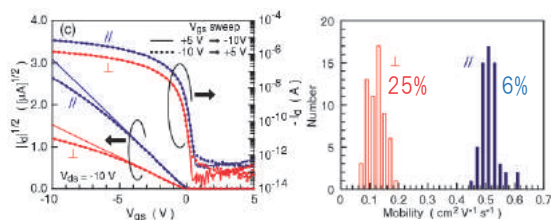
- For practical applications of organic devices, high performance, high operational stability, and suppression of dispersion in device characteristics are essential.
- Development of thin film formation techniques of organic semiconducting molecules with capability of molecular alignment control.

Advanced Research Topics

Formation of highly oriented films of small semiconducting molecules



Flow-coating (FC) method.

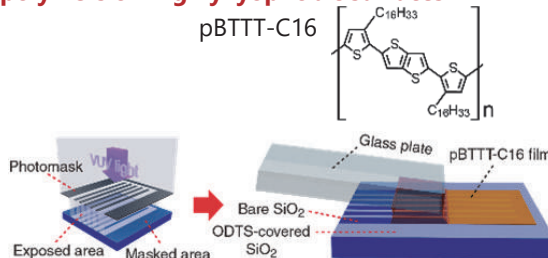


Typical transfer characteristics (left) and dispersion in charge carrier mobility (right) of organic field-effect transistors (OFETs) fabricated by FC.

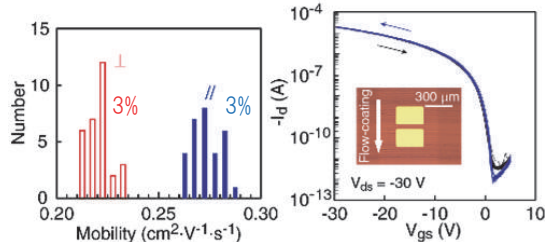
Publications

- K. Bulgarevich, K. Sakamoto, T. Minari, T. Yasuda, and K. Miki, *ACS Appl. Mater. Inter.* **9**, 6237-6245 (2017).
- K. Sakamoto, K. Usami, and K. Miki, *Appl. Phys. Express* **7**, 081701 (2014).
- K. Sakamoto, J. Ueno, K. Bulgarevich, and K. Miki, *Appl. Phys. Lett.* **100**, 123301 (2012).

Thin-film formation of semiconducting polymers on highly lyophobic surfaces



Self-assisted flow-coating (SAFC) method.



Dispersion in charge carrier mobility (left) of OFETs fabricated by SAFC and overlaid transfer curves of 30 parallel devices (right).

Applied area and future prospects

- FC and SAFC are expected to be useful in the field of printed and organic electronics.
- Enhancing mobility by increasing the degree of alignment of semiconducting polymers.
- Developing novel coating techniques of organic semiconductors towards high operational stability.

Issues for technology transfer

- Simultaneous realization of high performance, high operational stability, and small device-to-device variation.
- Design of coating machines suitable for production lines.