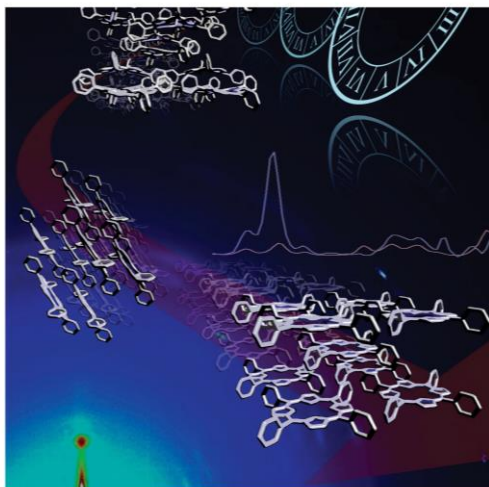


CRYSTAL GROWTH & DESIGN

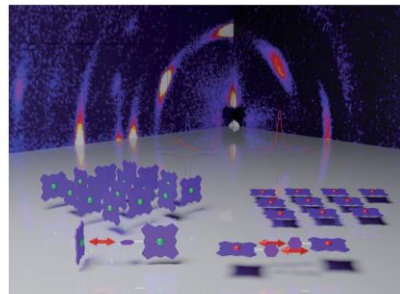
September 2
Volume
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INTEGRATING
FIELDS OF CRY
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CRYSTAL GROWTH /
THE SYNTH
AND APPLICATI
OF NEW MATER

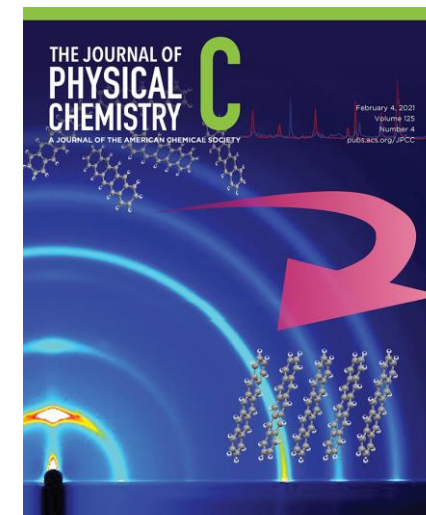


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Showcasing research from Professor Takashi Hasegawa's laboratory, Institute for Chemical Research, Kyoto University, Gokisocho, Uji, Kyoto, Japan. Image designed and illustrated by Kazutaka Tomita. Control of supramolecular organizations by coordination bonding in tetraporphyrin thin films. By changing the central metal ion of tetraporphyrin.



[Organic Semiconductor Group] 2022 Research Introduction

Projects

1 Selective control of molecular orientation

✓ *Sci. Rep.* **2019**, 9 (1), 579.

2 Understanding of crystal growth at the substrate interface

✓ *Appl. Phys. Express* **2020**, 13 (9), 095505.

3 Control and analysis of on-surface reactions

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✓ *Chem. Eur. J.* **2016**, 22 (46), 16539–16546.

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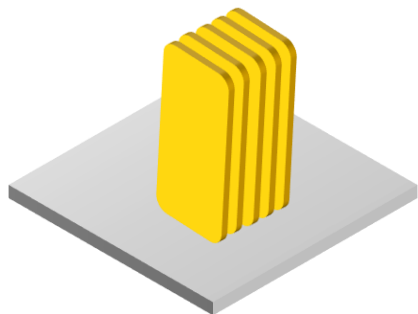
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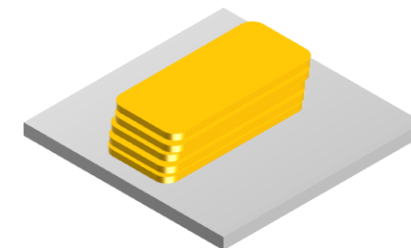
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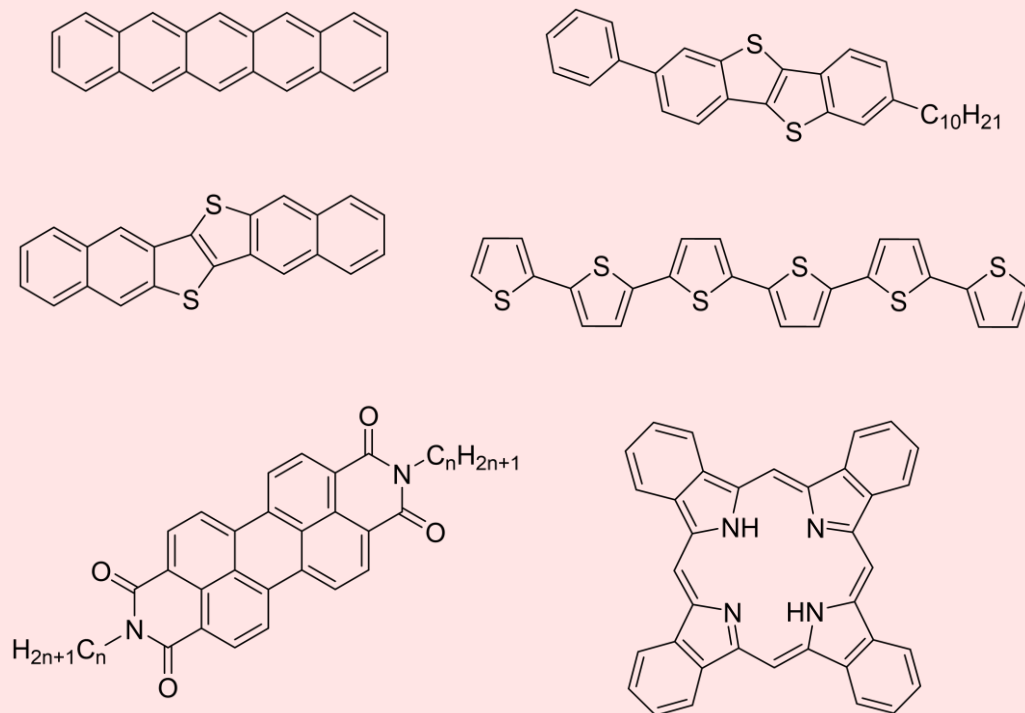
Molecular orientation of organic semiconductors



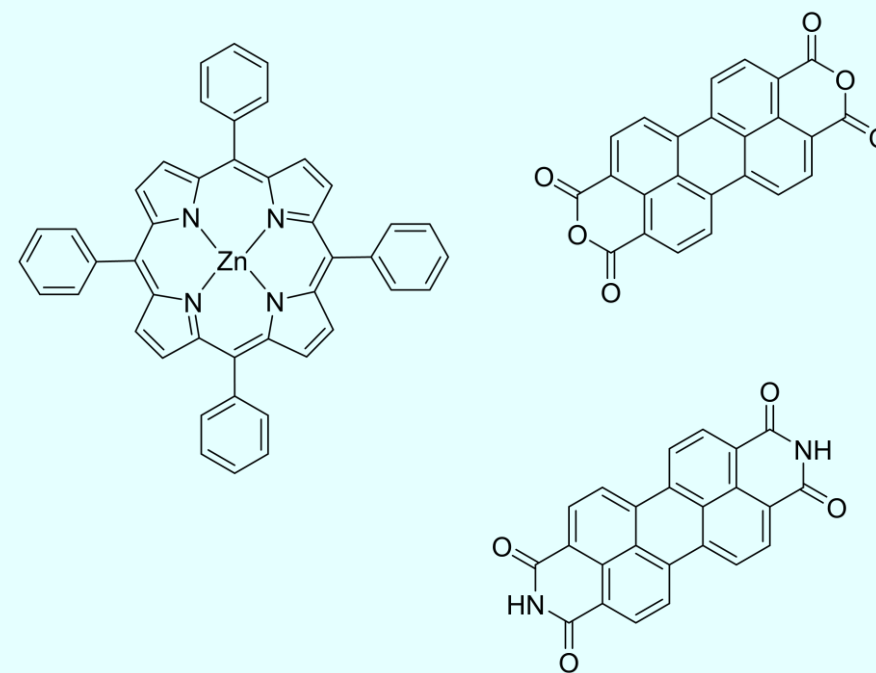
Selective control of molecular orientation



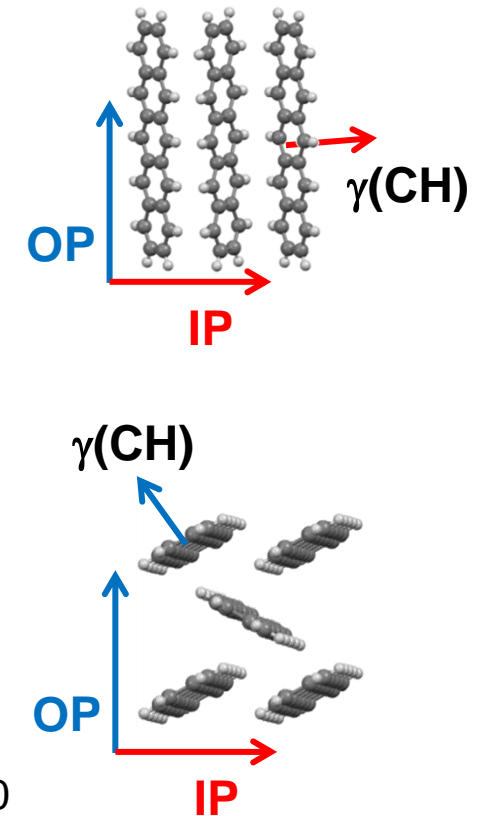
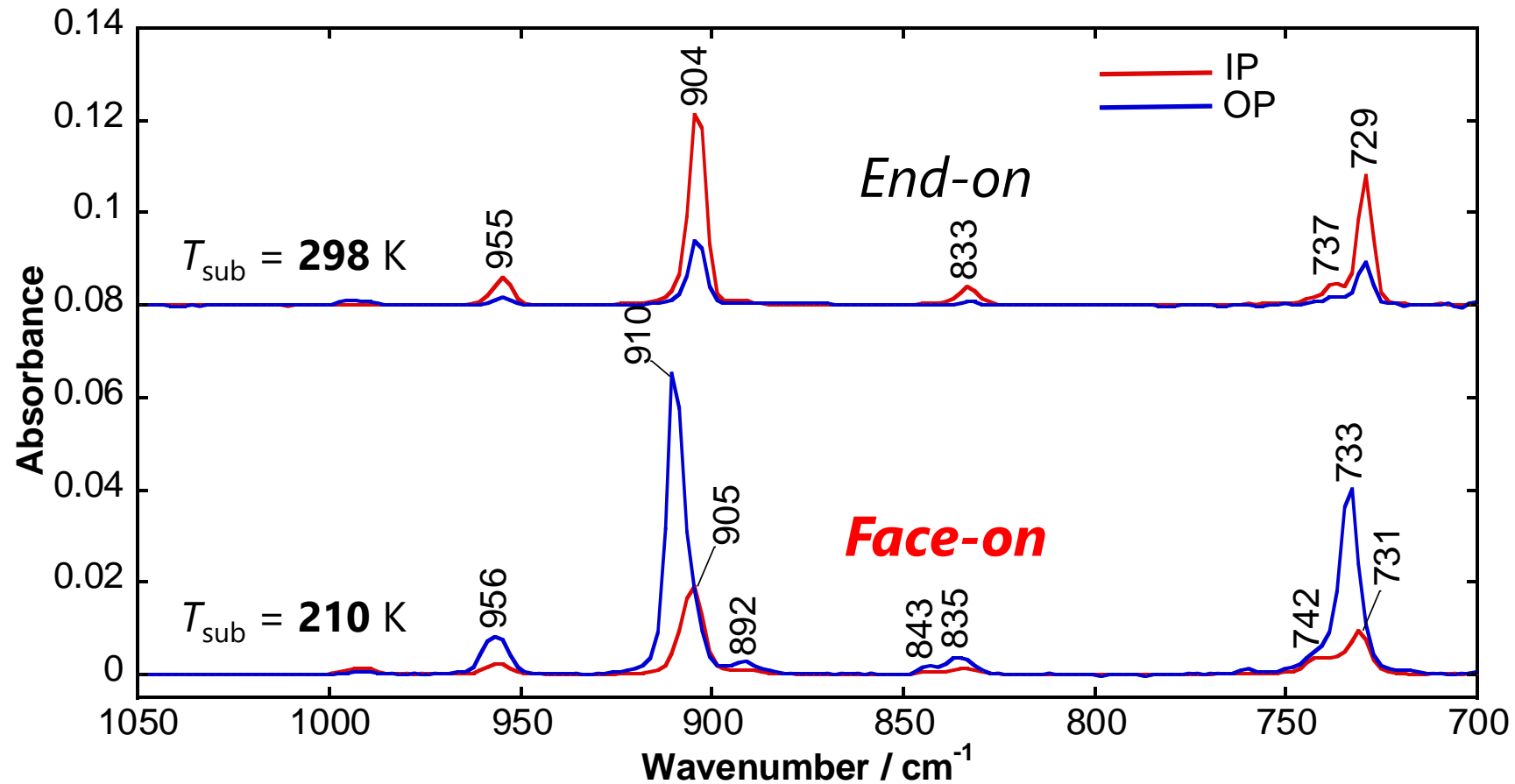
End-on



Face-on



Alternative face-on thin film structure of pentacene



Achievement of **face-on orientation** of pentacene on silicon

Sci. Rep. **2019**, 9, 579.



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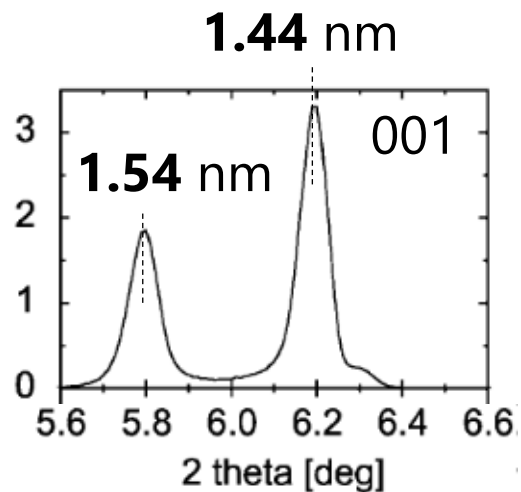
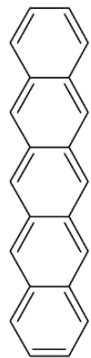
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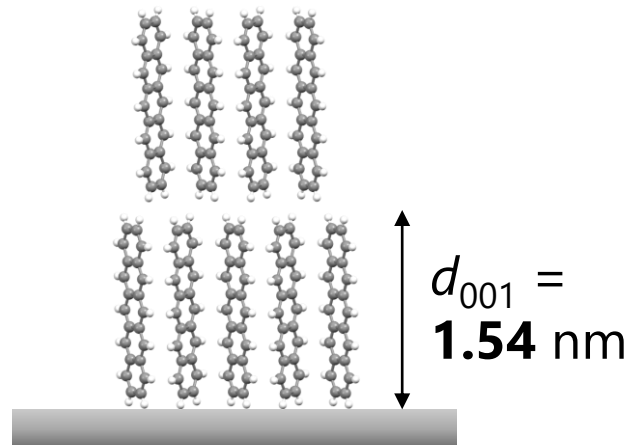
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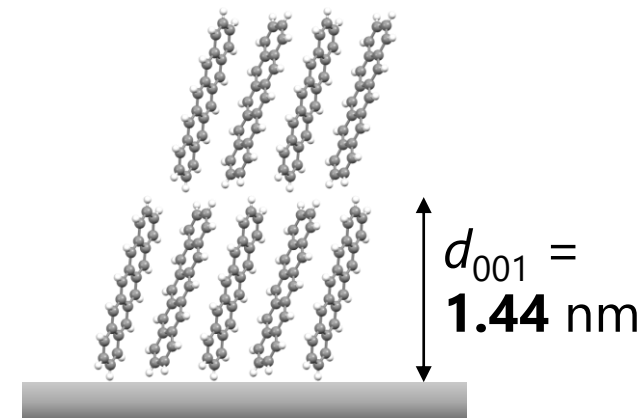
Thin-film phases of organic semiconductors



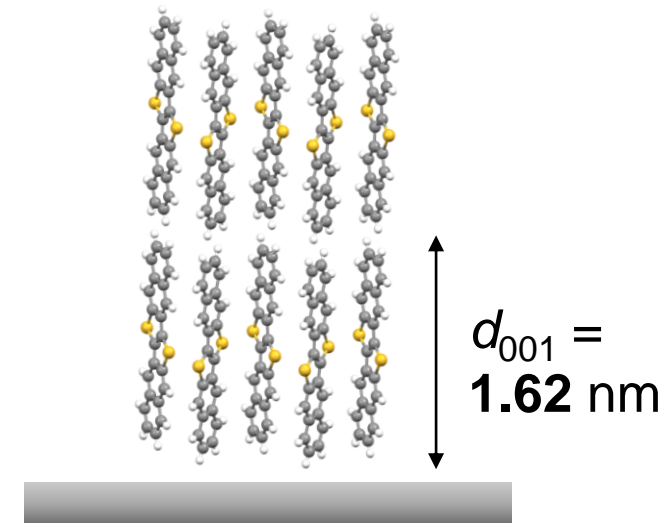
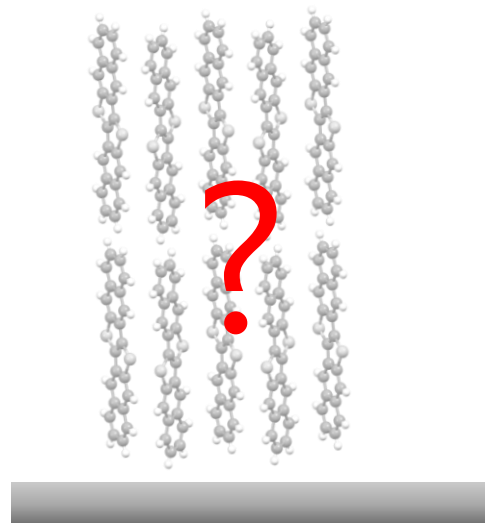
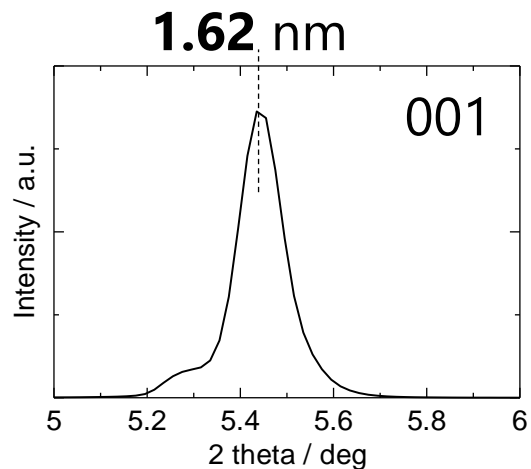
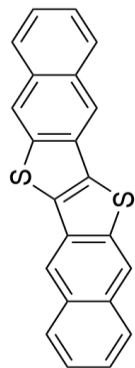
Thin-film phase



Bulk phase

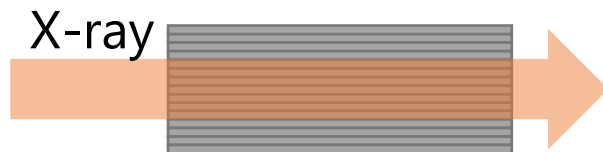


Mattheus et al., *Synth. Met.* **2003**, 138, 475.

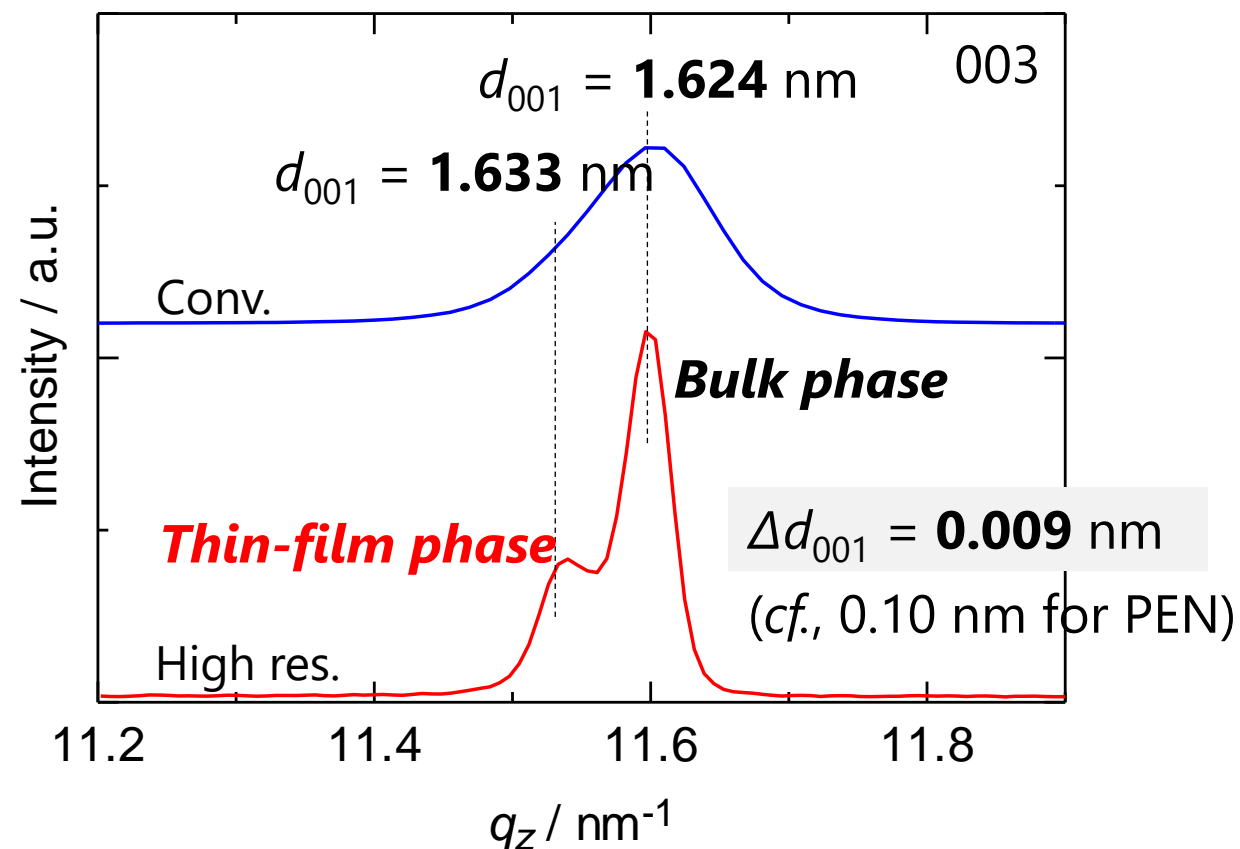
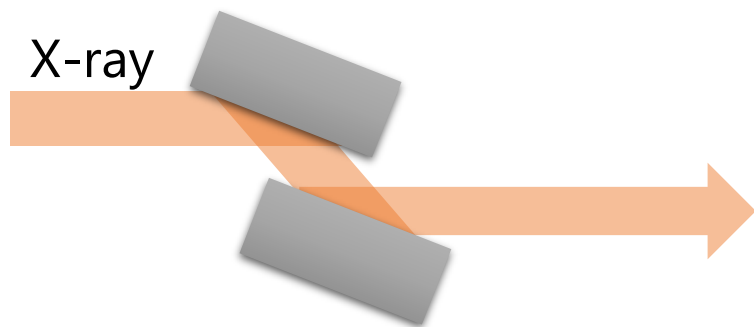


Hidden thin-film phase of DNTT

Soller slit (Conventional)



Ge monochromator (High resolution)



Identification of **thin-film phase** of DNTT on silicon

Appl. Phys. Express **2020**, 13, 095505.



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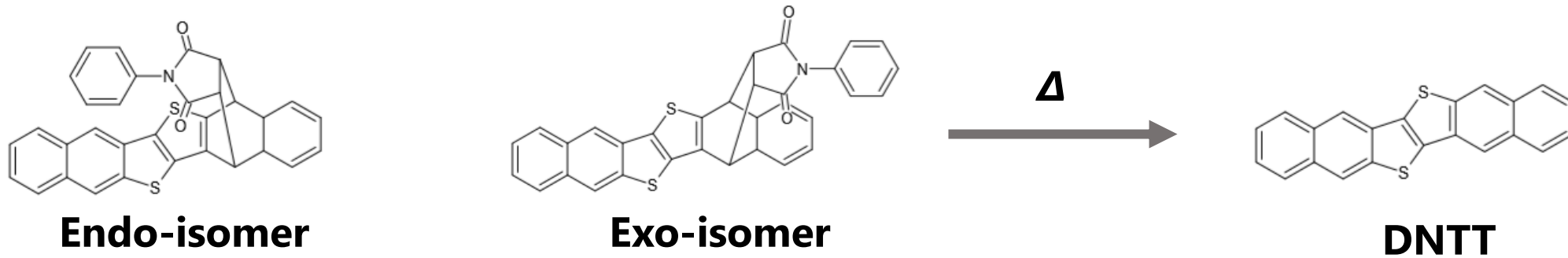
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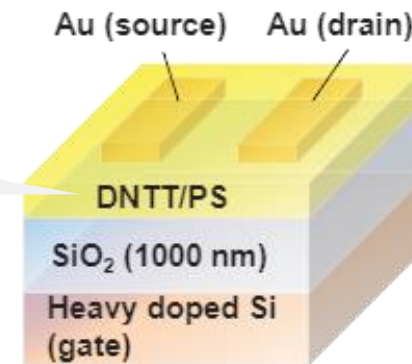
Thermal conversion of DNTT precursors



3.35 cm² V⁻¹ s⁻¹

OFET
mobility

0.94 cm² V⁻¹ s⁻¹

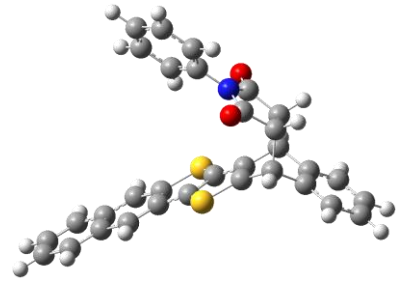


[1] Hamaguchi, A. et al. *Adv. Mater.* **2015**. 27, 6606.

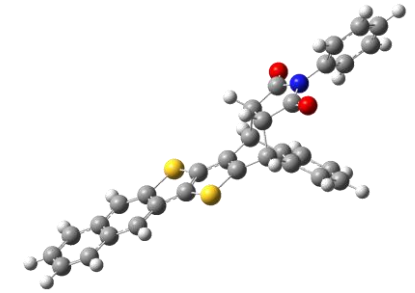
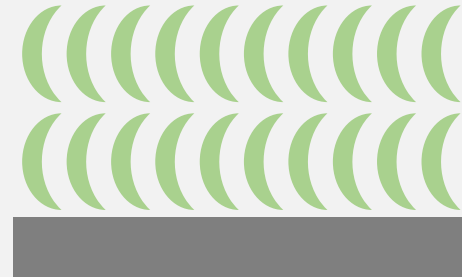
[2] Kimura, Y. et al. *Adv. Mater.* **2015**. 27, 727.

The structure-property relationship remains unresolved.

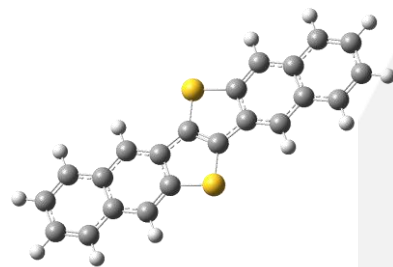
Stereoisomer-dependent conversion



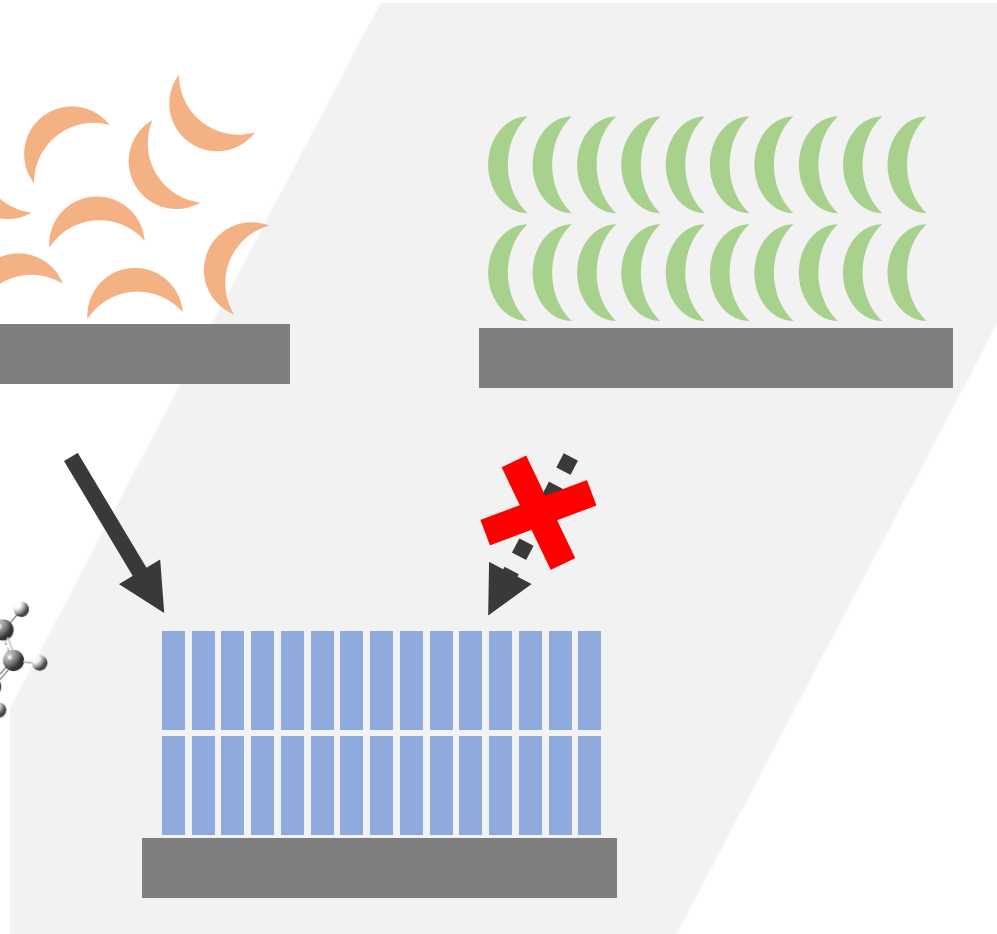
Endo-isomer
(High mobility)



Exo-isomer
(Low mobility)



DNTT



Control of ***on-surface reactions*** of DNTT precursors

Sci. Rep. **2022**, 12, 44448.



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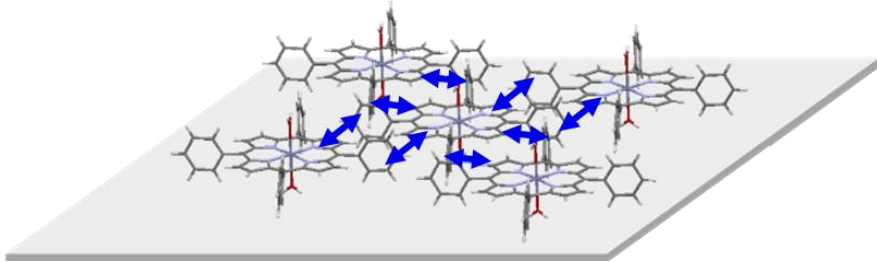
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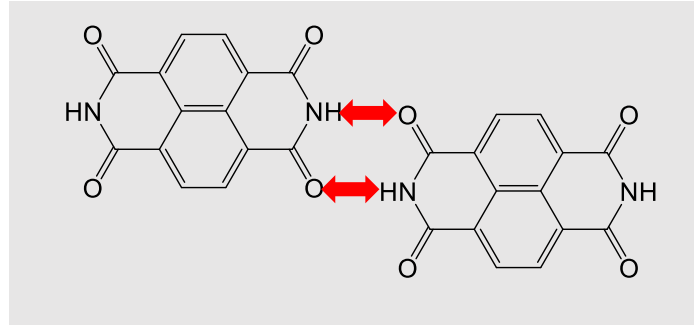
Supramolecular organizations in thin films

- ✓ Molecular design strategy for **face-on** orientation

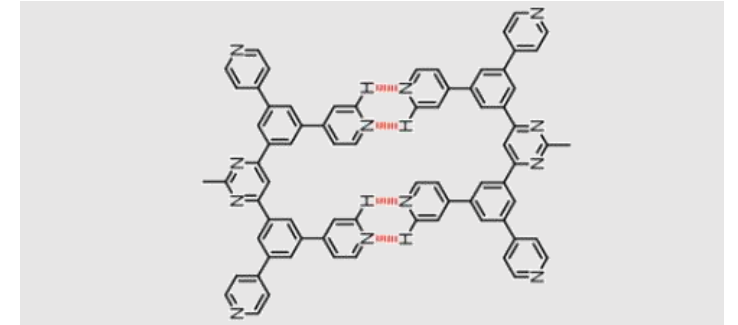
C-H/ π interaction



Hydrogen bonding



C-H/N interaction



Yokoyama. D. et al. *Adv. Funct. Mater.* **2011**, *21*, 1375.

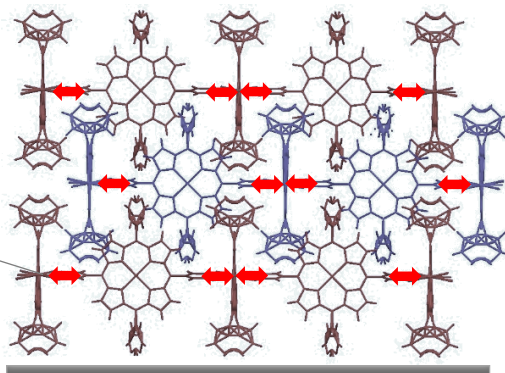
- ✓ Molecular design strategy for **edge-on** orientation

No report!

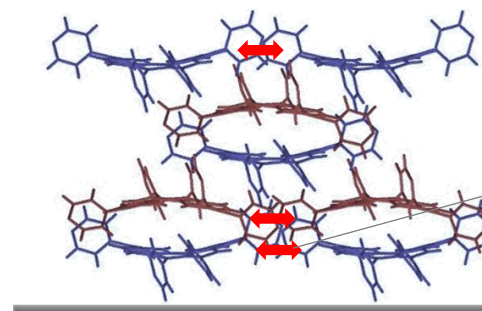
Control of supramolecular organizations

M^{2+}	Fe^{2+}	Co^{2+}	Ni^{2+}	Cu^{2+}
$d_{x^2-y^2}$	—	—	—	↑
d_{z^2}	—	↑	↑↓	↑↓
Molecular orientation	Edge-on	Random	Face-on	Face-on

Metal/N coordination



C–H/N interaction



Achievement of **edge-on orientation** of porphyrins

Chem. Commun. **2022**, 58, 2116.

