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Solution-processed 2D molecular crystals for transistor applications

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2D organic materials with in-plane van der Waals forces among molecules have unique characteristics that ensure a brilliant future for multifunctional applications. Soluble organic semiconductors can be used to achieve low- cost and high-throughput manufacturing of electronic devices. However, achieving solution-processed 2D single-crystalline semiconductors with uniform morphology remains a substantial challenge. Here, we successfully fabricated 2D molecular single-crystal semiconductors with precise layer definition by using a floating-coffee-ring-driven assembly. Field-effect transistors (FETs) yielded high carrier mobility up to 13.0 cm2/Vs. Besides, we demonstrated a simple and efficient approach to directly write 2D organic crystals using a rollerball pen. Furthermore, using our 2D molecular crystals, we achieved low-voltage FETs with the carrier mobility up to 9.8 cm2/Vs and high-speed ferroelectric OFET memory devices. More recently, we proposed an antisolvent-assisted spin-coating approach to achieve large-area molecular monolayers with the interfacial templating effect. Moreover, all our devices possess record-high electrical performances. Therefore, our results can help improve solution-coated 2D molecular single crystals in low-cost, large-area, and high-performance electronic applications.

Dr. Yun Li received his PhD degree from the Department of Physics, Nanjing University (China) in 2010. From 2010 to 2012, he had been as a postdoctoral researcher in NIMS (Japan). From 2012, he joined the School of Electronic Science and Engineering, Nanjing University. His current research interest is to achieve high-performance organic transistors based on organic crystals via efficient and simple fabrications through the use of novel materials, innovative device architecture as well as advanced techniques. His other interest is the fundamental study of the charge-transport in organic single-crystals, in particular the influence of interfacial properties on the charge transport of organic single crystal transistors. He was elected for the Jiangsu Provincial Science Fund for Excellent Young Scholars in 2017. In 2018, he was awarded the “Distinguished Lectureship Award” by the Chemical Society of Japan.

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