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Fabrication of sub-micron sized organic field effect transistors

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In this study, we report on the novel lithographic patterning method to fabricate organic-semiconductor devices based on photo and e-beam lithography with well-known silicon technology. The method is applied to fabricate pentacene-based organic field effect transistors. Owing to their solubility, sub-micron sized patterning of P3HT and PEDOT has been well established via micromolding in capillaries (MIMIC) [ref1]and inkjet printing techniques.[ref2] Since the thermally deposited pentacene cannot be dissolved in solvents, other approach was done to fabricate pentacene FETs with a very short channel length (~30nm),[ref3] or in-plane orientation of pentacene molecules by using nanometer-scale periodic groove patterns as an alignment layer for high-performance pentacene devices.[ref4] Here, we introduce the atomic layer deposition of Al_2O_3 film on pentacene as a passivation layer. Al_2O_3 passivation layer on OTFTs has some advantages in preventing the penetration of water and oxygen and obtaining the long-term stability of electrical properties.[ref5] AZ5214 and ma N-2402 were used as a photo and e-beam resist, respectively. A few micrometer sized lithography patterns were transferred by wet and dry etching processes. Finally, we fabricated sub-micron sized pentacene FETs and measured their electrical characteristics.

Ref1. Org. Electron. **2007**,*8*,389
Ref2. Science **2000**,*290*,2123
Ref3. Adv. Mater. **2003**,*15*,1632
Ref4. Adv. Mater. **2008**,*20*,1146
Ref5. Appl. Phys. Lett. **2008**,*93*,163304