Fabrication of sub-micron sized organic field effect transistors

박성찬, 허정환, 김규태, 하정숙

1고려대학교 화공생명공학과, 2고려대학교 전기공학과

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) and inkjet printing techniques. 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), or in-plane orientation of pentacene molecules by using nanometer-scale periodic groove patterns as an alignment layer for high-performance pentacene devices. Here, we introduce the atomic layer deposition of Al2O3 film on pentacene as a passivation layer. Al2O3 passivation layer on OTFTs has some advantages in preventing the penetration of water and oxygen and obtaining the long-term stability of electrical properties. 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.

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