

Fabrication of Poly(methyl methacrylate) patterns via printing technique combined with Langmuir Schaefer method and its application to forming micro-structures

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Poly(methyl methacrylate)(PMMA) has been widely used as passivation layers for the formation of micro- and nano-structures via e-beam and nano-imprint lithography.

In this work, we fabricated PMMA micro- patterns on SiO₂/Si substrates over large areas by the simple printing method using a polymer stamp inked with PMMA via Langmuir-Schaefer(LS) technique. The thickness of transferred PMMA patterns could be controlled from 1 nm to 80nm by the repetition number of LS inking process, ~ 1.3 nm per each inking.

We have investigated the application of the PMMA patterns. First, the transferred PMMA patterns could be used as a passivation layer in chemical etching of SiO₂ by buffered oxide etchant. We fabricated the embedded electrode on SiO₂ via e-beam evaporation of metal on the patterned substrate and the subsequent lift-off of the PMMA layer. By use of such formed embedded electrodes, we fabricated the organic thin film transistor of P3HT with a bottom gate and measured its electrical properties. Second, PMMA patterns were used in the fabrication of isolated V₂O₅ nanowire channels on the desired site of SiO₂/Si substrates in the following way: 3-aminopropyltriethoxy silane (APS)/PMMA pattern of open square shape was fabricated by printing of PMMA on APS-treated substrates. Then, V₂O₅ nanowires were selectively adsorbed on the APS area via direct printing of the nanowires using hydrophilic poly(dimethylsiloxane) stamp. Finally, PMMA was removed by acetone and the resultant isolated nanowire micro-channels could be obtained.