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Fabrication of Single-Walled Carbon Nanotube and V_2O_5 Nanowire micro-channels using micro-contact printing techniques

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In these works, SWCNTs and V_2O_5 NWs can be positioned on the desired sites of the substrates with preferred orientation via two independent soft lithography procedures. First, poly-methylmethacrylate (PMMA) patterns were transferred onto 3-aminopropyltriethoxysilane (APS)-treated SiO_2 substrate by stamping poly(dimethylsilioxane) (PDMS) stamp inked with Langmuir-Schaeffer films of PMMA. Second, preferential adsorption of SWCNTs on the APS-treated area was performed during tilted-drop casting, where the PMMA patterns worked as successful passivation layers. Third, the PMMA patterns were removed by lift-off method using acetone. SWCNTs were commonly aligned along the direction parallel with the line pattern where the width of the APS region was smaller than the average length of SWCNT. For the patterning of V_2O_5 NWs, direct printing of V_2O_5 NW inked PDMS stamp, which had been modified to be hydrophilic by ultraviolet-ozone treatment, onto the SiO_2 substrate was done. Interestingly, V_2O_5 nanowires on the stamp were aligned perpendicular to the direction of stamp pattern by gas flow in blowing step for removing excess V_2O_5 ink. By selective transfer of the nanowire on relief region of PDMS stamp in the subsequent printing procedure, both the aligned and the length-controlled V_2O_5 nanowire channels with pattern size could be obtained.

We also fabricated the cross-junction arrays of SWCNTs and V_2O_5 NWs via integration of the above-mentioned two lithography processes and characterized electrical junction property between SWCNTs and V_2O_5 NWs network percolation channels.