Patterning of V_2O_5 nanowires via Langmuir-Blodgett technique combined with μ-contact printing

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We devised facile method to pattern V_2O_5 nanowires onto hydrophobic as well as hydrophilic substrates via Langmuir-Blodgett (LB) and Langmuir-Shaeffer (LS) techniques combined with μ-contact printing. It is easy to disperse V_2O_5 nanowires into water, but hard to float on water surface. Use of dioctadecyldimethylammonium bromide (DODAB) as surfactant made V_2O_5 nanowires float on water surface without any chemical treatments. The LB isotherm data and the AFM measurements show that the composite films of $DODA^+/V_2O_5$ nanowires are formed on water surface. It is considered that the electrostatic interactions between the $DODA^+$ and negatively charged V_2O_5 nanowires in the acidic aqueous solution makes the stable composite film on water surface. LB method enables the transfer of highly ordered conformal $DODA^+/V_2O_5$ nanowire composite films onto any substrates regardless of the hydrophobicity of the substrate. AFM study shows that V_2O_5 nanowires are aggregated under the $DODA^+$ islands whose heights are ~ 5nm. Transfer of the well-ordered LB film of $DODA^+/V_2O_5$ nanowires onto the patterned poly dimethylsilioxane (PDMS) stamp and subsequent stamping onto the 3-aminopropyltriethoxysilane-treated SiO_2 substrate resulted in the fabrication of V_2O_5 nanowire patterns. Only $DODA^+$ islands can be selectively removed by rinsing with DI-water from transferred patterns of $DODA^+/V_2O_5$ composite film without deformation. Infrared spectroscopy, DSC/TPA, and EDX-SEM measurements also supported the transfer mechanism of the V_2O_5 nanowires.