Robust surface functionalization of ZnO nanowire with high chemical stability for chemical sensor applications

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ZnO nanowire is one of the best semiconducting materials in term of its superior properties, such as large piezoelectric constant, wide band gap energy (3.37 eV), large exciton binding energy (60 meV), high thermal and mechanical stability. Therefore, it is suitable for the fabrication of variety of devices which includes transparent transistors, optoelectronic devices, chemical and biological sensing. Although ZnO nanowires are one of the promising candidates for various applications, robust surface functionalization methods with solubility and chemical stability under wet solutions still remain a great challenge for chemical sensor applications. In this work, we present schematic studies of chemical stability for functionalization methods of ZnO nanowires, including covalent bonding of the silane based modifier and surface polymerization using plasma for chemical sensor. The chemical stability and pH sensing of the functionalized ZnO nanowires were evaluated under various pH solutions. The chemical modification and solubility of the functionalized ZnO nanowires were investigated by scanning electron microscopy, transmission electron microscopy, fourier transform infrared spectroscopy and X-ray photoelectron spectroscopy. Finally, surface reaction mechanisms for the nanoscale chemical sensors will be discussed. This study provides several useful guidelines for optimizing the stability and sensor performance for chemical sensor.