ZnO single nanowire based sensor and UV detector

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A great deal of attention has been focused on one-dimensional ZnO nanostructures because of their superior properties such as high surface-to-volume ratio and high crystalline quality. A nanodevice made from single nanowire attracts substantial research interests because it can provide a unique platform for fundamental investigations. As the surface-to-volume ratio is very high, surface plays a crucial role to determine the electrical and optoelectronic properties of the single nanowire based devices.

Vertically aligned ZnO nanowires (Figure 1a) were grown by MOCVD technique and Schottky dioded of ZnO single nanowire (Figure 1b) with different metal (Au, Ni and Pt) have been fabricated by e-beam lithography. The junction properties of ZnO nanowire based Schottky diodes with different contact metal were studied. UV detection and gas sensing properties of single nanowire based Schottky diode were measured.

The single nanowire based Schottky diodes were used for room temperature hydrogen sensor (Pt/ZnO nanowire) (Figure 1c) and UV detector (Au/ZnOnanowire) (Figure 1d). Hydrogen-sensing behaviour of Pt/ZnO nanowire Schottky diode has suggested that it has good sensing characteristic ($S \approx 90\%$) at room temperature with a response time of ~ 55 s.

The sensitivity shows a maximum at room temperature for H_2 concentration of 2500 ppm and decreases very slowly with an increase in temperature, whereas it increases slowly with temperature for H_2 concentration of 500 ppm. The schottky contact and ZnO surface yield unambiguous information on the UV detection mechanism, particularly in cases where the intensity of UV light is low. In case of Schottky diode, low power UV detection is significant.

Figure 1: (a) FESEM of ZnO Nanowires. (b) Single nanowire Schottky diode. (c) H_2 sensitivity with concentration. (d) UV response characteristics.