



## CHAPTER V CONCLUSIONS

Polyaniline was synthesised by an oxidative polymerization using peroxydisulfate as an oxidant. Hydrochloric acid, maleic acid, and camphor sulfonic acid were used as dopants. The synthesized PANI emeraldine base and the doped PANI were characterized for the structure, crystallinity, and doping level using FT-IR, EA, TGA, SEM, and XRD.

The FT-IR spectra were comparable to the published papers. The elemental analysis and TGA results indicates that the actual doping levels amongst the three dopants at  $N_A/N_{EB}$  of 10 differ slightly; their doping levels are 82.48, 90.53, and 86.01%, respectively. The specific conductivity of the doped PANI increases with doping level, which is well correlated with the increasing crystallinity of the doped PANI. The specific conductivity of all PANI increases when exposed to CO/N<sub>2</sub> gas due to the co-existing of CO as a dopant at polaron site in PANI. The electrical response of the PANI doped with maleic acid at  $N_A/N_{EB}$  of 10 (PANI-10MA) is higher than that of PANI-1MA. This result corresponds to a higher number of polaron sites in PANI-10MA as compared to that of PANI-1MA.

Three zeolites were used in dry mixing with PANI-10MA to fabricate pellet composite sensors to detect CO. Zeolites Y, 13X were commercially available whereas AlMCM41 was synthesized in our laboratory. They have pore sizes of 7, 10, 36 Å, with the Cu<sup>2+</sup> exchange capacities of 0.161, 0.087, and 0.044 mol/g, respectively. With an addition of 13X zeolite to the pristine polyaniline, the sensor sensitivity to CO/N<sub>2</sub> gas increases with zeolite content. For the effect of zeolite type, the highest sensitivity was obtained with the zeolite 13X, followed by the zeolite Y, and the AlMCM41 zeolite. Poor sensitivity of the zeolite AlMCM41 was probably due to its very large size and its lowest ion exchange capacity. The 13X zeolite and the Y zeolite have comparable pore sizes but the former has a greater pore free volume and a more favorable location distribution of the Cu<sup>2+</sup> ion. The temporal response time increases from 237 min to 300 min as 13X zeolite content increases from 0% to 40%. For a composite with a higher zeolite content, a more CO

molecules can adsorb and diffuse into the composite and thus they require a longer time before the interaction with polyaniline chains to complete and the specific electrical conductivity to reach a steady state value. However, the temporal response time of PANI-10MA/10-Y is smallest followed by the zeolite 13X, and the AlMCM41; they are 169, 250, and 365 min, respectively. The temporal response time is inversely related to the amount of ion exchange capacity.