

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Ultrafine silica and tin oxide fibers were successfully prepared by the calcinations of e-spun PVA/silatrane and PVA/tin glycolate composite fibers at various temperatures ranging between 400° and 1100°C. The diameters of the composite fibers increased with an increase in the concentration of the base PVA solution, while they decreased with an increase in the applied electrical potential. The applied electrical potential has not only significant impact to the size and the surface morphology of the fiber but also collection distance. In case of e-spun PVA/tin glycolate composite fibers, the fiber diameter and the bead formation were decreased with increasing collection distance. HNO₃ is not only a good candidate to be a catalyst for the sol-gel processing of tin glycolate, but also provides small size of SnO₂ fibers after calcination. The average diameter of the post calcined e-spun PVA/tin glycolate composite fibers decreases from 166 ± 46 nm to 87 ± 18 nm with increasing the calcinations temperature from 400 to 1000°C and of the post calcined e-spun PVA/silatrane composite fibers decreases from 213 ± 53 nm to 162 ± 40 nm with increasing the calcinations temperature from 500 to 1100°C, respectively. The silica fibers, obtained from calcination at temperatures ≥ 700°C, were composed predominately of cristobalite. The BET surface areas of the silica fibers were in a range between 87 and 285 m²/g. The tin oxide fibers obtained were tetragonal rutile. Moreover, raising the heat treatment temperature from 600 to 1000°C causes the decrease in surface areas and specific conductivity. The ultrafine tin oxide fiber showed the high conductivity value of 1.59 × 10³ Scm⁻¹ and the highest BET surface area of 275 m²/g at the 600°C calcinations temperature.

The CNT-SiO₂ and the CNT-TS-1 hybrid materials were also successfully prepared using silatrane precursor. Both of them revealed a nondestructive, simple process to coat CNTs using benzyl alcohol as linking agent. The highest photocatalytic activity was observed for the CNT-TS-1 hybrids with 30 wt% CNTs,

up to 6 times higher than those observed for the corresponding nano-composite and both individual components. In addition, the hybrids selectively degraded Rh-B via cleavage of the aromatic rings, in contrast to pure TS-1, which preferred the slower degradation via deethylation.

Pure silica nanotubes with high surface area to mass ratio have been successfully prepared for the first time using a carbon nanotube template for the deposition of an amorphous silica coating, and subsequently converted to cristobalite, found at temperature 700°C and above. Based on the FTIR and the WAXD results, it is postulated that the use of silatrane as the source of silica favors the formation of cristobalite.

8.2 Recommendations

1. The effect of the amount of the carbon nanotube on the morphology of the hybrid material should be investigated.
2. Other interesting materials, such as ZSM-5, Fe-ZSM-5, VS-1, should be coated on pristine CNTs to study the efficiency of the catalyst.
3. Other types of carbon nanotube, i.e. acid-treated carbon nanotube, anneal carbon nanotube, graphene which has different surface areas should be studied as template for coating TS-1 to compare their photocatalytic activities.