

# Chapter 5

## Conclusions

### 5.1 Solution Deposition Method

1. Catalytic particle size was increasing from 40 nm to 100 nm with increasing H<sub>2</sub> plasma pretreatment time, but the number of catalysts was obviously getting decreased for 60 min.
2. By increasing the growth time, the length of tubes was increased from about 100 nm to 2 μm and the diameter also was from 50 nm to 100 nm. As growth time reached up to 60 minutes, amorphous carbons deposited on the surface of tubes, proved from the I<sub>D</sub>/I<sub>G</sub> data.
3. With increasing the carbon source, the length and diameter of tubes were increased but the I<sub>D</sub>/I<sub>G</sub> ratio was decreased.
4. As MPCVD power was reached up to 200 W, the glass substrates were bending and damaged at 620 °C.
5. From TEM images, herringbone-like structure and carbon nanofiber structures were found, and both structures were curved, as a result of forming defective edges with pentagons and heptagons which eventually induced bending in carbon nanotubes.
6. The turn-on voltage of 10 μA/cm<sup>2</sup> was 3.2 V/μm for the sample under 150 W and growth time of 30 min.

### 5.2 Sol-Gel Method

1. After H<sub>2</sub> plasma pretreatment, the number of catalysts was increased with the time from 5 min to 45 min.
2. With increasing the growth time, the diameter was increased from 20 nm to 70 nm

at 150 W. Similarly, at 200 W the diameter was also increased from 20 nm to 80 nm and the specimens were not bending.

3. With increasing the carbon source the length and diameter of tubes were increased, but the  $I_D/I_G$  ratio was decreased, it implied the CNTs became well-graphitic.
4. From TEM images, herringbone-like structure and carbon nanotubes structures were found, and both structures were curved.
5. The turn-on voltage of  $10 \mu\text{A}/\text{cm}^2$  at 150 W for 30 min was  $5.4 \text{ V}/\mu\text{m}$  and at 200 W for 60 min turn-on voltage was  $6.4 \text{ V}/\mu\text{m}$ .

