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Structural characteristics of carbon nanostructures synthesized by ECR-CVD

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Outline

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- Experimental
- Results and discussions
- Conclusion
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Intraduction

Carbon nanotubes (CNTs) have attracted great interest and have the potential for several promising applications, such as probes for atomic force microscopes (AFM), electron emitters for field emission displays (FED) , nanofillers for composite materials , and electrodes for fuel cells.

In addition, CNTs can interface with various materials, and are thus very practical. The other materials can be biomolecules, inorganic materials, and polymer coatings.

These CNTs, however, are strictly influenced by the processing parameters, which may have different mechanical, electrical, and optical properties.

Experimental

Using ion beam sputtering (IBS), nickel (Ni) was used as the catalyst in this work to deposit on an n-type 10~10 mm2 Si substrate at room temperature.

The thickness of the nickel catalyst was about 5–10 nm. In turn, an ECR-CVD system was used to grow CNTs. The base pressure and power were set at 10-6Torr and 400 W, respectively.A flow ratio of propane (C3H8) to hydrogen (H2) of 1:1 was supplied to the system.

Propane was used in this study because it provides a lower temperature flame and is safer . The substrate temperature was kept at 600 ºC for 5 min.

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Results and discussions

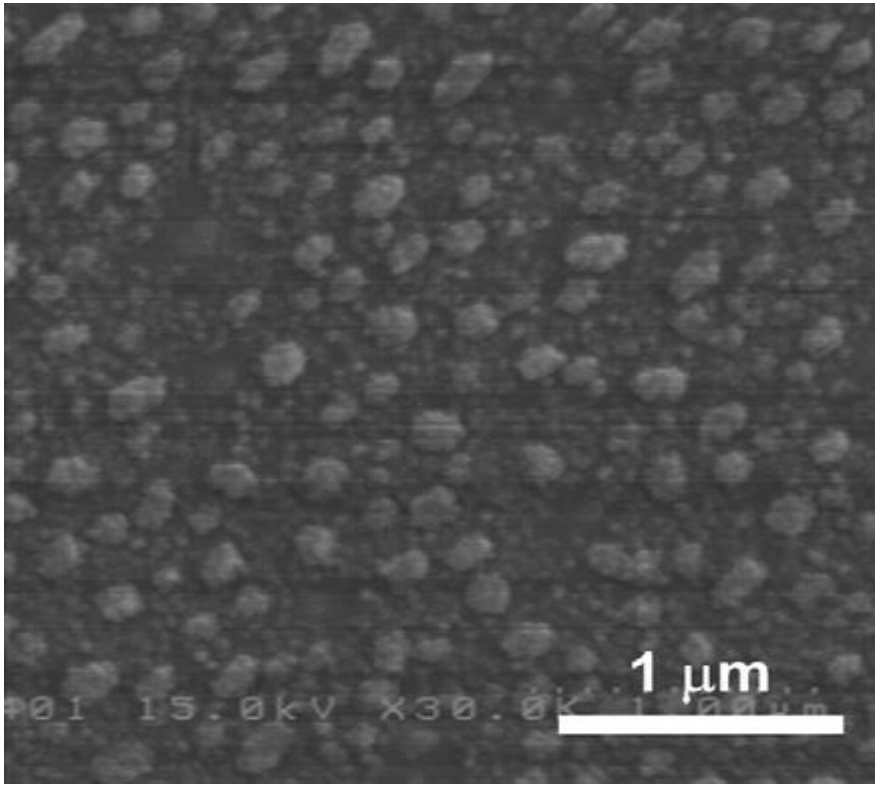

Fig. 1. Morphology of the Ni deposited on the Si substrate.

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Results and discussions

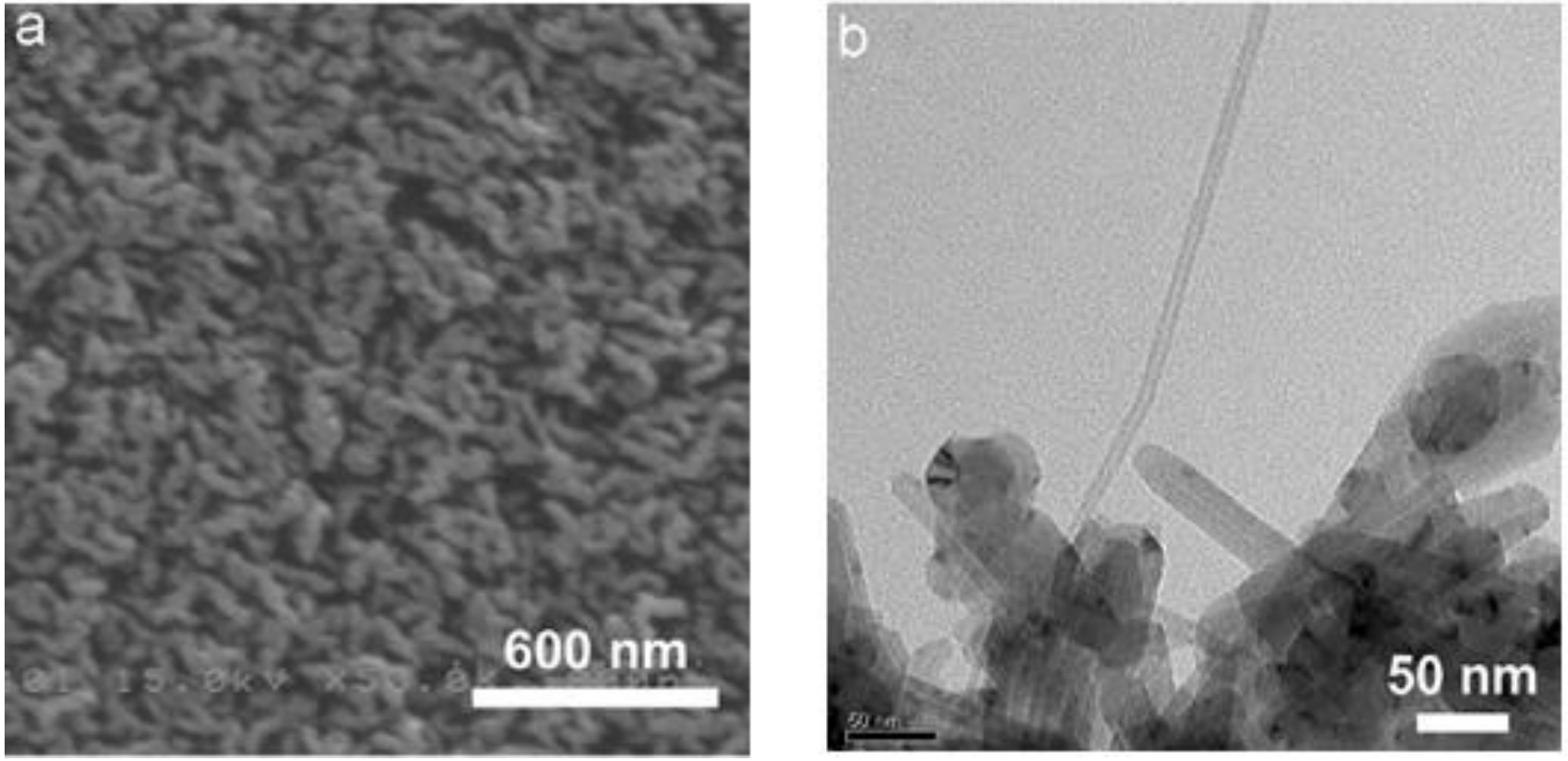

Fig. 2. Morphology of the bundles of the CNTs sample by (a) FE-SEM and (b) FEG-TEM.

Results and discussions

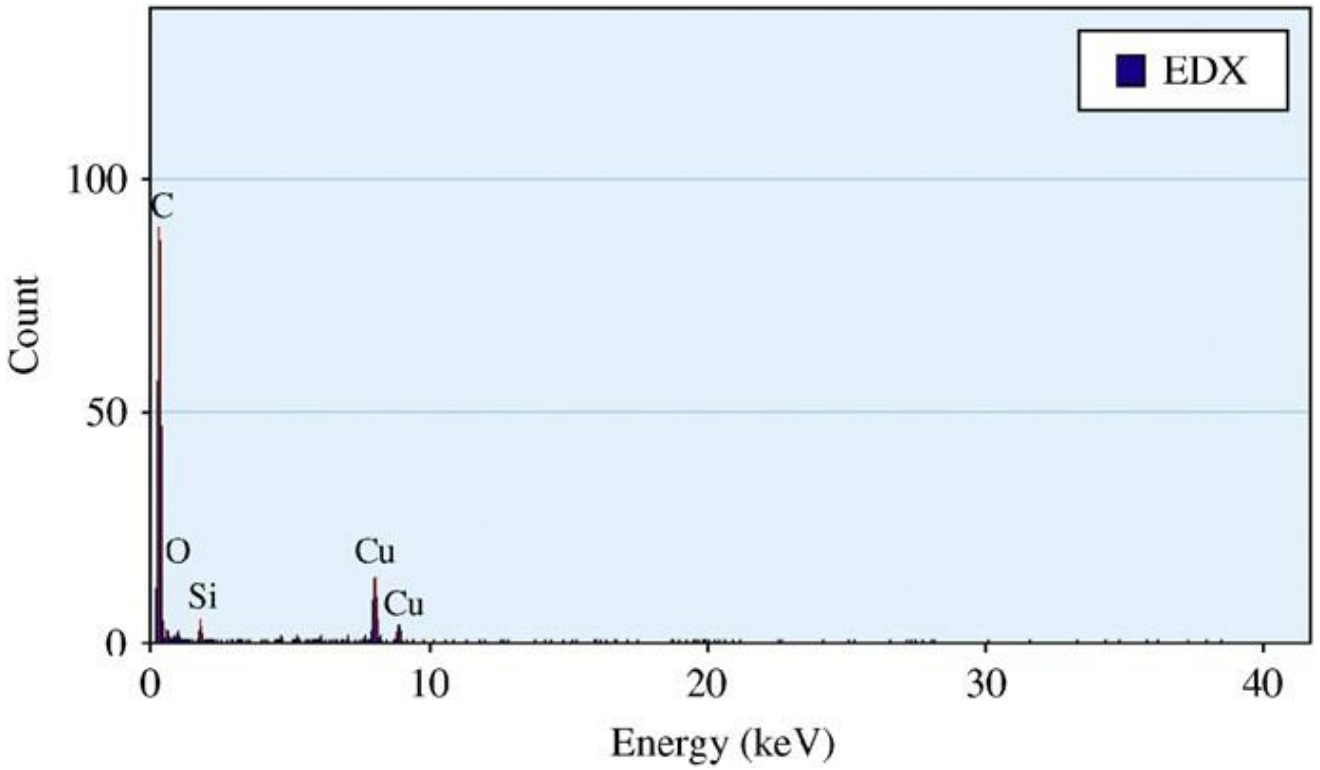

Fig. 3. EDX spectrum of the CNTs sample.

Results and discussions

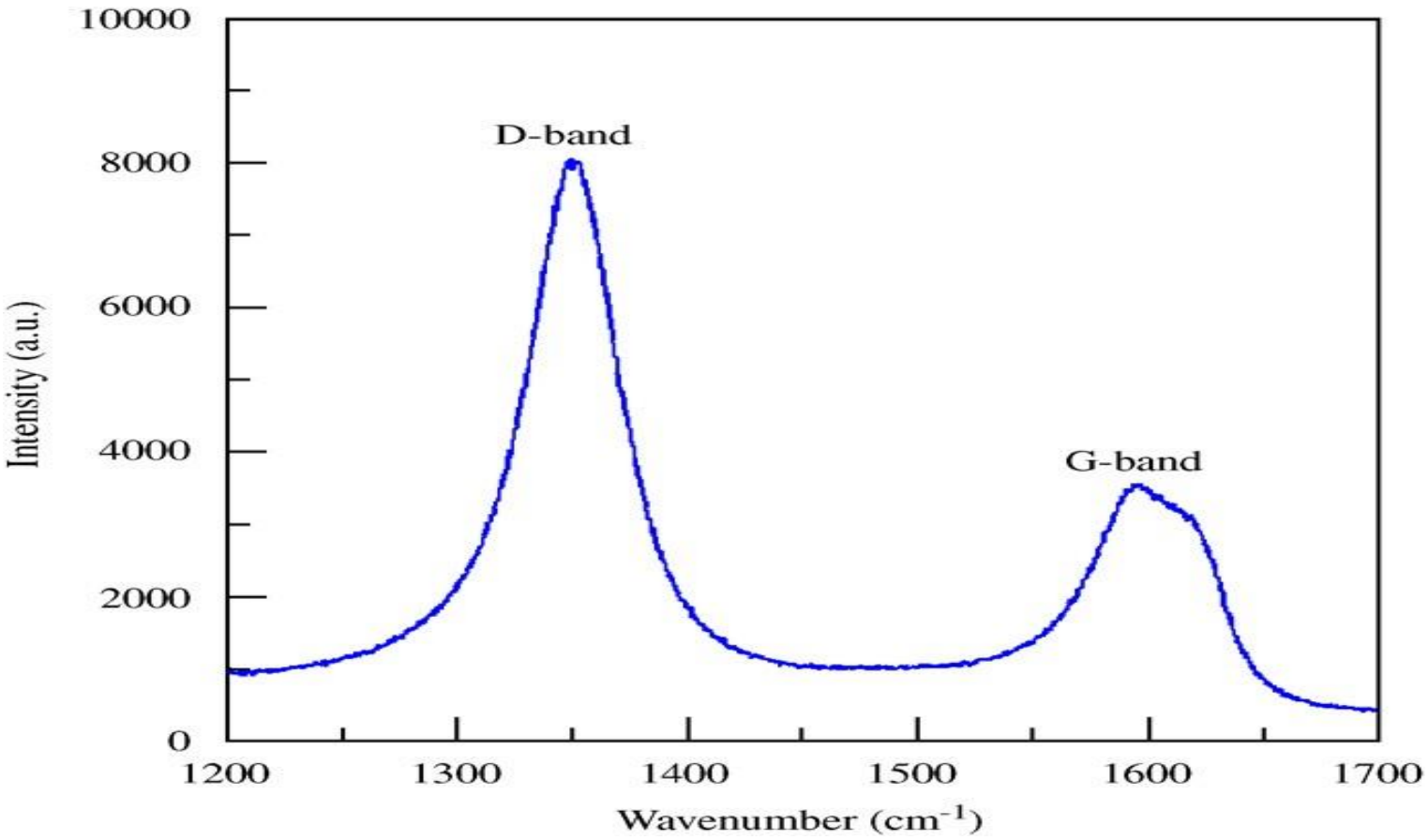

Fig. 4. Raman spectrum of the sample containing CNTs and nanoparticles.

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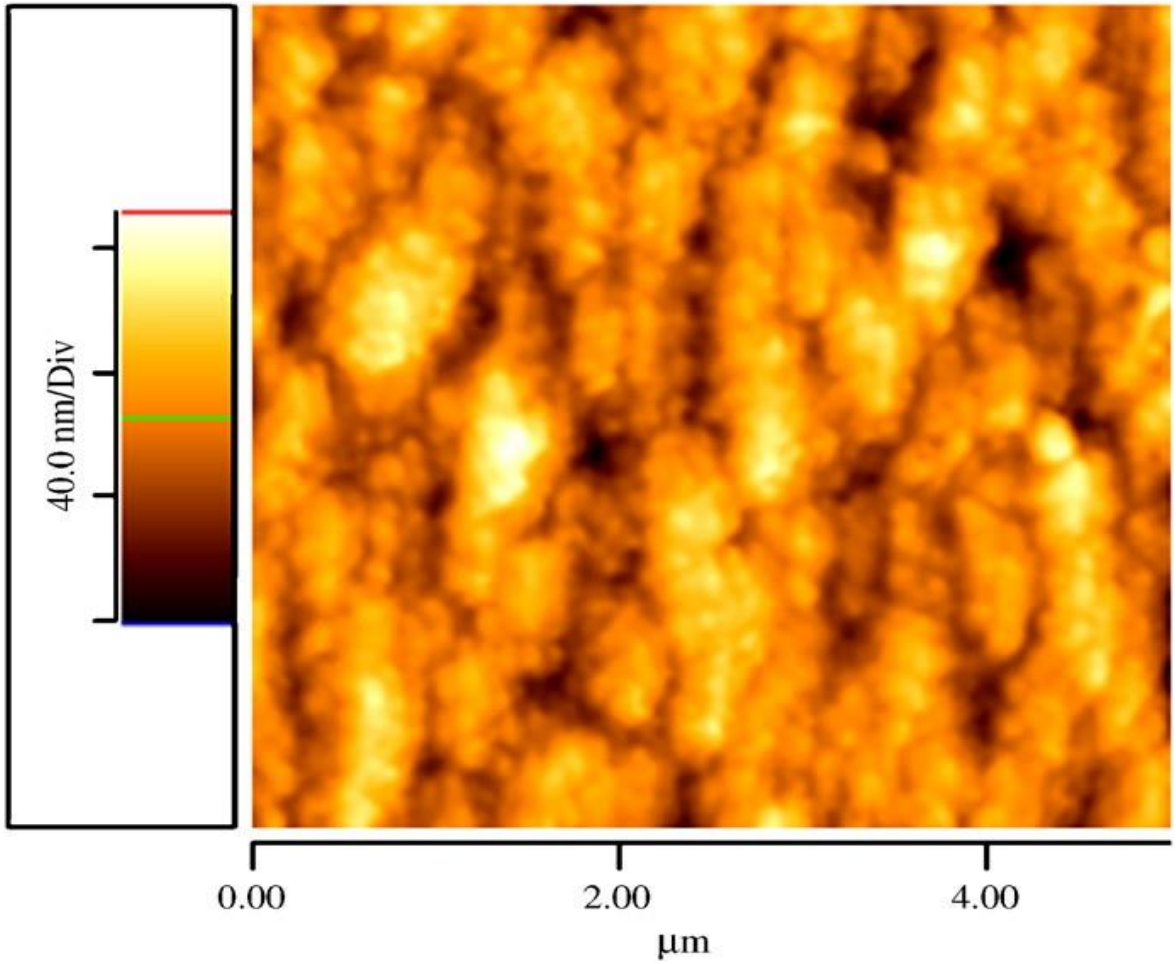

Fig. 5. AFM image of the CNTs and nanoparticles.

Results and discussions

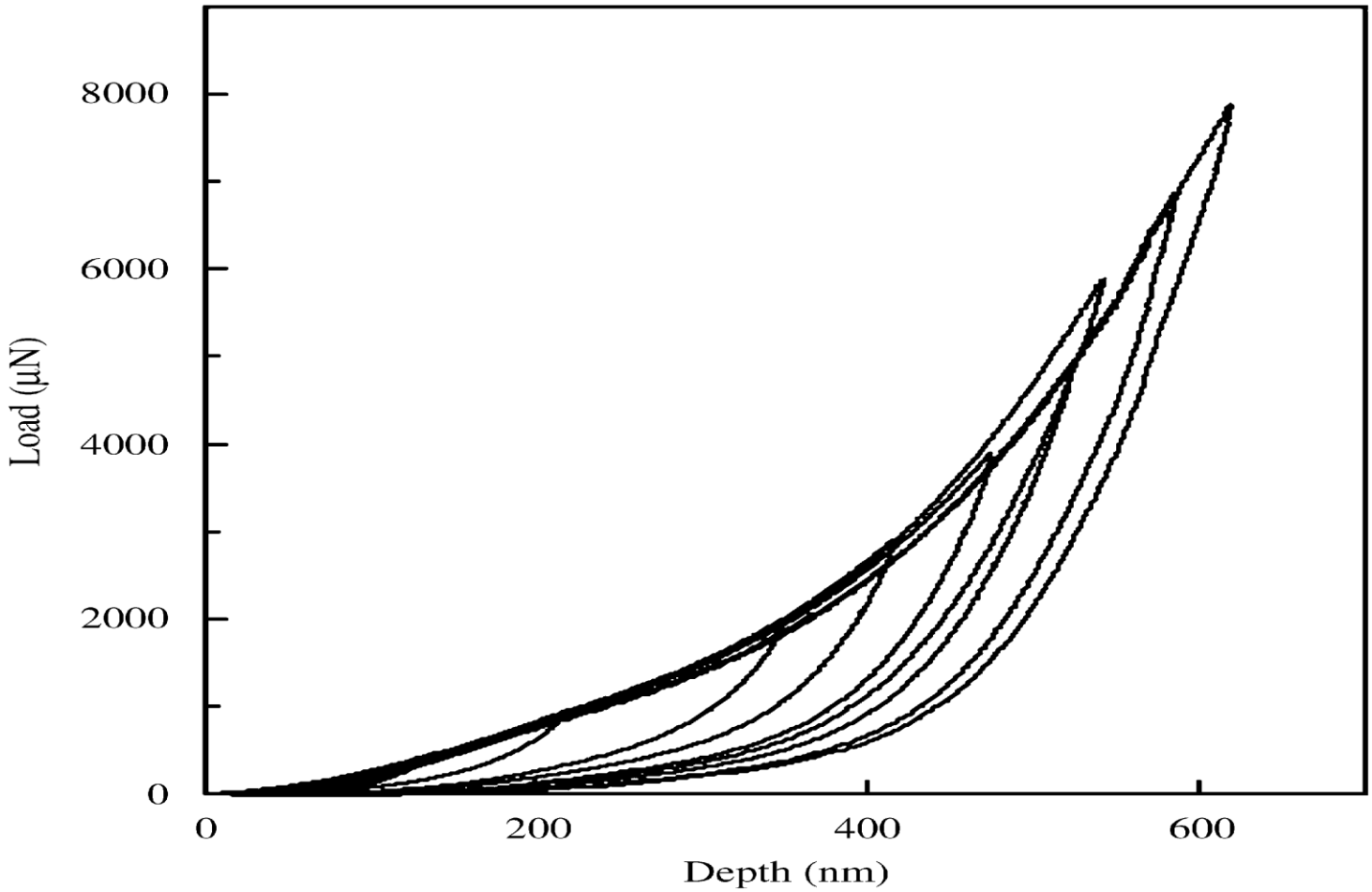

Fig. 7. Nanoindentation load-depth curve of the CNTs sample.

Results and discussions

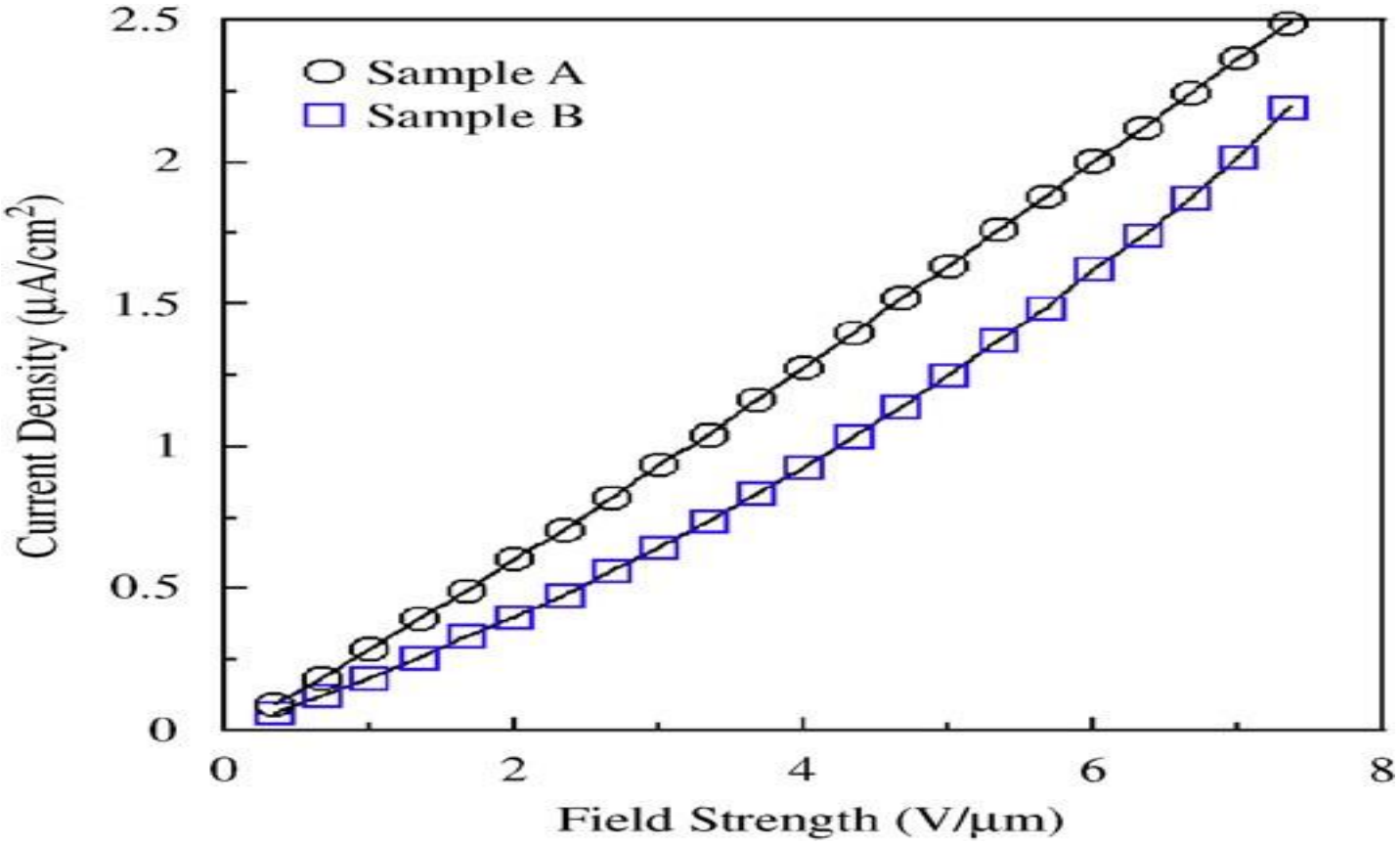

Fig. 8. Field emission characteristics of the CNTs samples (sample A with larger nanoparticles and sample B with smaller nanoparticles).

Conclusion

The growth of the CNTs is only from the internal tilt wall lamination, while the external layer is gradually etched over time and ultimately a tubular cone is formed.

The surface sheet resistance and average surface roughness of the CNT films are about 360 Oper square and 7–17 nm, respectively.

The CNT sample has a higher amount of nanoparticles, the current density will be increased.

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Thanks for your attention !