Industry Day Theme #

{EMERGING NANO AND ADVANCED MATERIALS}

Nano ring formation of MWCNT by dewetting of thin film

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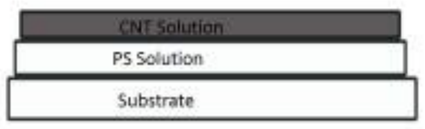
Abstract

Toroidal or circular ring carbon nanotubes are unique structure. These structures are formed by the self-organization of thin polystyrene film due to formation of arrays of holes because of dewetting. These surface structures can be of great use in biomedical purposes like skin grafting, sensors, superhydrophobic coating and others.

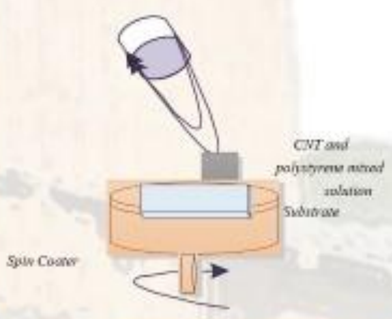
Introduction

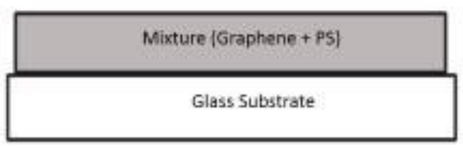
Spontaneous formation of ordered patterns or structures on the surface has wide range of technological applications. Retraction of fluid from the surface that it was supposed to cover leads to the phenomenon of dewetting. Similarly carbon nanotubes can self-assemble and form various topology like coiled CNTs, CNT junctions and toroidal CNTs. The self-organized patterns on the thin PS film along with Marangoni flow is the driving force behind the circular ring formation.

Materials and Methods



Concentration of CNT solution = 0.1 g/L
Polystyrene solution 1 % (w/w)





Conclusions

- **Origination of toroidal CNT structure without any extravagant method.**
- **Simple self-organization of polystyrene because of dewetting acts as a template for the directed self-assembly of CNT particles forming toroidal structures.**
- **Surface tension gradient is the driving force behind the arrangement of the circular ring patterns of the CNT particles.**

Industrial Significance

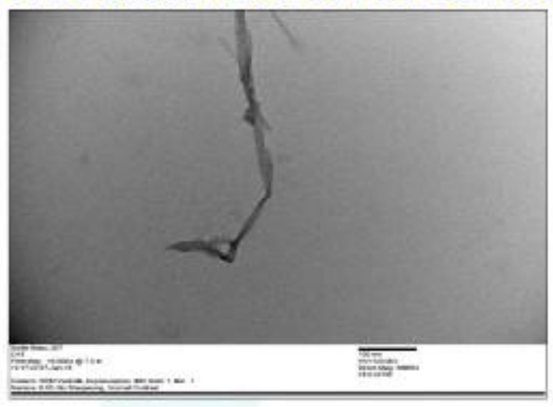
The morphologies can be used for biomedical purposes-artificial skin grafting, sensors for detection of cancerous cells, electro magnetic nano switches and nano devices for energy storage.

Technology Readiness Level

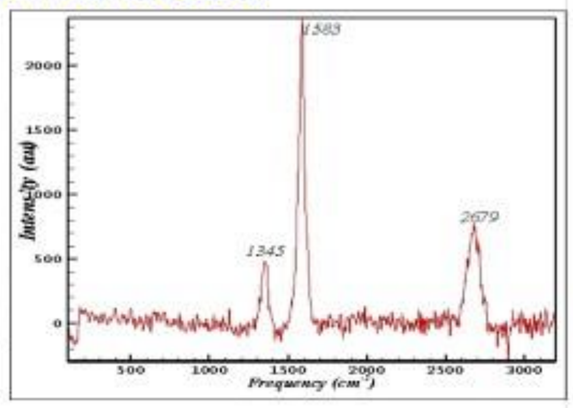
The basic morphologies are only formed, not yet ready for technology transfer.

Result

Characterization of Carbon nanotube

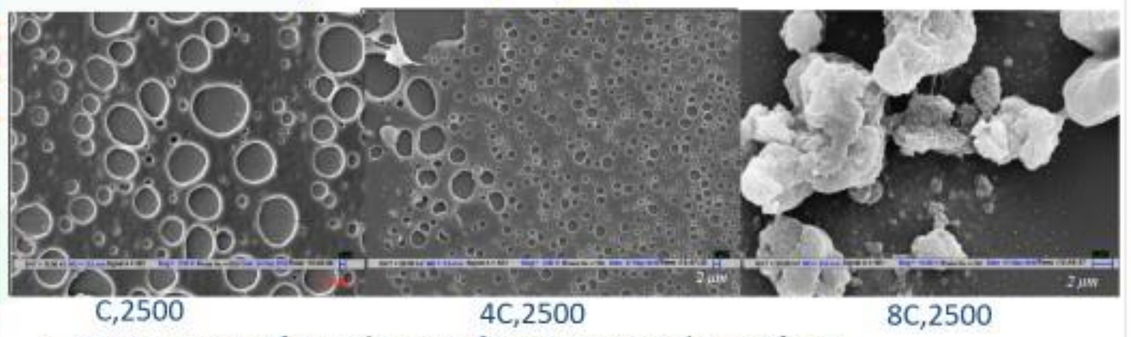


TEM micrograph of multiwall carbon nanotubes diameter 0.72 nm and length of tube 16 nm



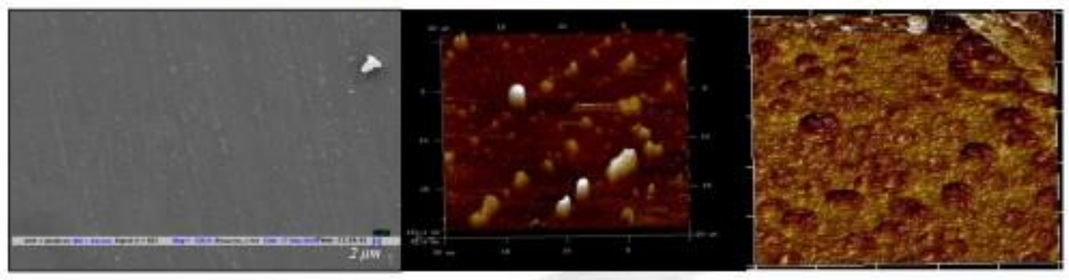
The Raman spectroscopy of CNT particles measured with 514 nm laser shows a peak for G band at of 1583 cm^{-1}, 2D band is at 2679 cm^{-1} and the D band is at 1345 cm^{-1}

CNT as a bilayer over polystyrene film



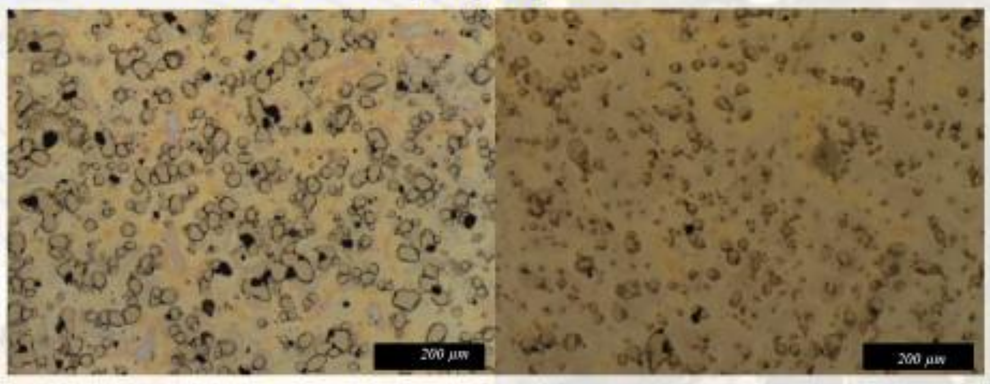
C,2500 4C,2500 8C,2500

- SEM images of circular ring formation on the surface.
- CNT particles at the edge of the rings.
- With increase in concentration , agglomeration is formed.



- Movement of the particles on the surface.
- Formation of lines on the surface due to movement of the particles.
- Circular loops with nanoparticles.

CNT as a mixture with polystyrene



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- Reiter, Günter, and Rajesh Khanna, *Langmuir* 16.15 (2000): 6351-6357.
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Department of Chemical Engineering