

# Percolation behaviour of polymer/multi-walled carbon nanotubes composites



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## General

Conductive composites offer many functional applications in manufacture of sensitive microelectrodes, pressure, deformation, and temperature variation sensors, sensors for chemical vapours electromagnetic shielding materials, thermistor devices for electrical heaters, electro-conductive rubbers.

## The aim of work

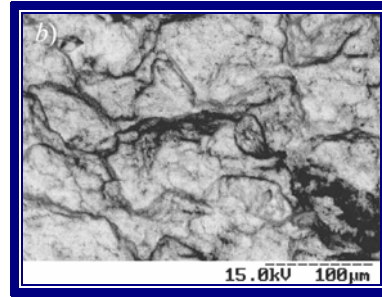
is to investigate the percolation behaviour in polymer/multi-walled carbon nanotubes (MWCNT) composites

## Introduction

Owing to the high aspect ratio (100-1000) and specific surface areas of the CNTs, the percolation threshold in a polymer filled with the CNTs can be achieved at a very low concentration of the CNTs, within the range of 0.0025 to 4 wt%. CNTs possess a high tensile strength, modulus and significantly stiffer than currently available carbon fibers.

So, CNTs are expected to serve as conductive and mechanical reinforcements of for lightweight composite materials with various applications.

Structure of composite near the percolation threshold



## Theoretical prediction

The percolation threshold concentration  $\varphi_p \approx [1 - (1 + n/\lambda)^{-3}]p$

$\lambda = R/r$ ,  $R$  is the polymer particle size,  $r$  is the average size of a MWCNT,

$n$  is the effective number of monolayers of the MWCNTs at the polymer particle surface,

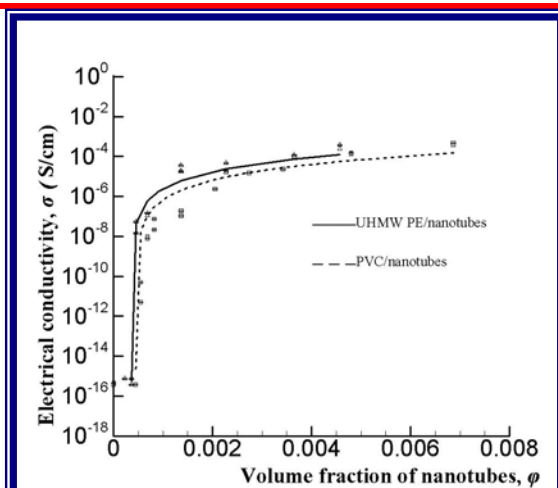
$p$  is the percolation threshold concentration of the nanotubes distributed between the large polymer particles.

## Conclusions

Both PVC/MWCNTs and UHMWPE/MWCNTs thermoplastic composites exhibit percolative type of behavior with very low percolation thresholds,  $\varphi_p \approx 0.04-0.13\%$ .

The filler homogenisation improvement by proper blending method potentially can result in additional decrease of the percolation threshold concentration  $\varphi_p$  close to the theoretically predicted limit  $\varphi_p \approx 10^{-4}\%$

## Percolation behaviour



## Acknowledgments

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## References

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