Resistivity Measurements of SWNT Polymers with Isotactic Polypropylene (iPP), Propylene-ethylene (PE) Co-Polymers

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Introduction

The carbon nanotube (CNT) concentration in the CNT-polymer nanocomposites influences the resistivity of the composites. We measured the resistivity versus temperature of SWNT composites with 0.15 %, 0.3 % and 1 % wt where PE 7.3, PE 15.6, and PE 22 represent the PE percentage in the co-polymer.

Experimental

The experiments were done by using four contact measurements and DC current source. We placed the sample in sealed probe on a copper sample holder with a Cernox thermometer in it. We put the probe into the cryostat and pumped out the air inside the cryostat and then filled with the Helium gas as the exchange gas.
We applied constant current through the sample using Keithley 220 programmable current source and then we measured the voltage difference using Keithley 6517A Electrometer/High resistance meter. The sample was cooled from room temperature to liquid Nitrogen temperature (about 77 K).

Results and Discussion

From fig.1 (left) we see the comparison between each concentration for resistivity versus temperature. We note that the highest resistivity is for 0.15 wt%. In fig.1 (right) we plot $\ln(\rho(T))$ versus $(1/T)^{\gamma}$ with $\gamma=1/4$, where we use the variable range hoping model (VRH) in order to obtain the characteristic energy barrier parameter T_0: $\rho(T) = \rho_o \exp(T_0/T)^{\gamma}$.

Conclusions

For each comonomer percentage, we note that T_0 increases with decreasing SWNT wt%. However there is no systematic dependence of T_0 on the PE percentage.

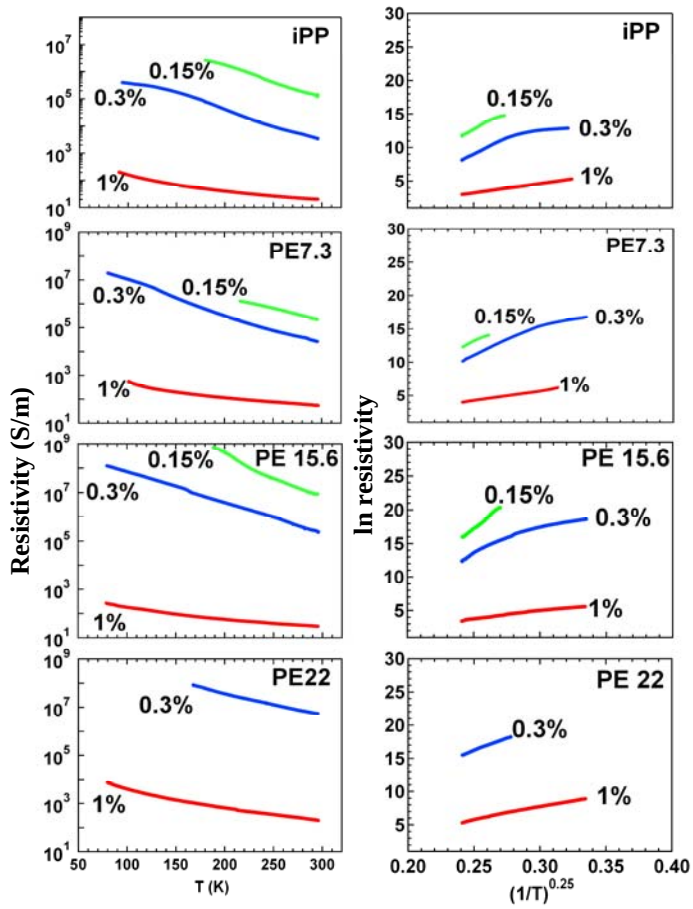

Fig 1. Resistivity versus temperature (left) and ln resistivity versus $1/T^{0.25}$ (right)

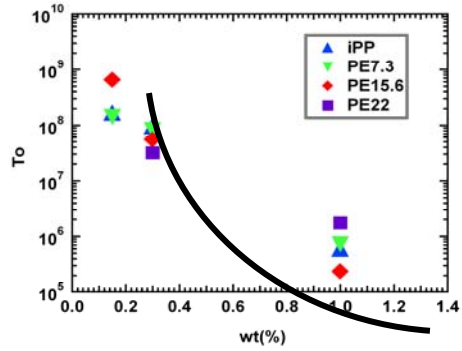

Fig 2. T_0 versus %wt concentration

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References

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