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Nano materials filled Polymers for reducing the thermal Peak temperature in a vehicle

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I. INTRODUCTION

There is an increasing demand for fuel nowadays and it is soon expected that there will be an acute shortage in the fuel that we are using at present. Hence there is a need to optimize the fuel usage.

Almost 10% of fuel in a vehicle is used for maintaining the temperature within it for the comfort level of the passengers and the main factor that influences this is the air conditioner in the vehicle have made a carbon nano tube which is blasted with Graphite vapors forming a chicken wired structure. It is then condensed with a polymer, which brings up the required behavior of the material i.e. it can act both as a sun proof sheet or as a normal transparent sheet (allows sunlight to pass through) according to the requirement. This can be stuck to the window pane. Now a voltage of 5V is given to change its behavior from sun proof sheet to normal sheet and vice versa. This eliminates the peak thermal temperature attained in the vehicle when parked and hence the work load of the AC is abruptly reduced.

II. FABRICATION OF CNT

Carbon nano tubes are tubular fibrous structures composed entirely of graphitic carbon planes. The carbon –carbon double bonds form a hexagon shape within the lamellar graphite planes that resemble common chicken wire. The orientation of the graphite planes is parallel to the fiber axis along with the seamless nature of tube structure that enables their extreme mechanical properties. This can be done by ball milling or by normal chemical vapor Deposition method. It is then condensed with a polymer such as SMP (Shape memory polymer) to get the required property .Large quantities of SWNTs can be synthesized by catalytic decomposition of methane over well-dispersed metal particles supported on MgO at 1000°C. The thus produced SWNTs can be separated easily from the support by a simple acidic treatment to obtain a product with high yields (70–80%) of SWNTs. Because the typical synthesis time is 10 min, 1 g of SWNTs can be synthesized per day by this method. The SWNTs are characterized by high-resolution transmission electron microscopy and by Raman spectroscopy, showing the quality and the quantity of products. The catalytic decomposition method was suitable for scaling up and for achieving a "controlled production" of SWNT. By this we implied the ability to control the selectivity towards SWNT by changing catalyst parameters and operating conditions, all combined with the ability to obtain a reliable quantitative measurement of the amount of SWNT produced. The CVD processes offer the best approach to the manufacturing of larger SWNT quantities, with perhaps the most scalable being the CoMoCAT process which uses a fluidized bed reactor (similar to those used in petroleum refining, albeit, on a much smaller scale.

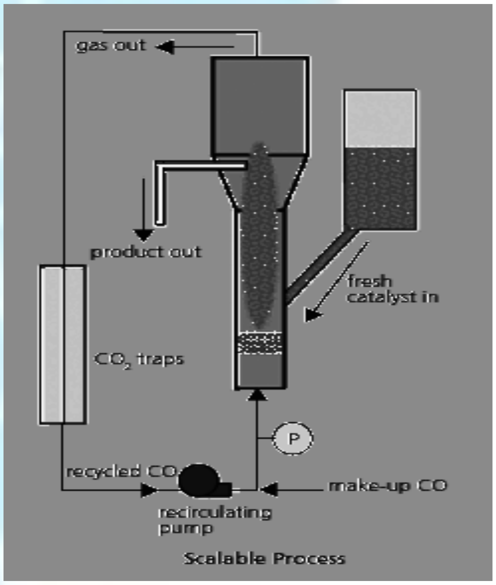


Fig .1 SCALABLE PROCESS

An illustration of a fluidized bed reactor which is able to scale up the generation of SWNTs using the CoMoCAT process. In this CoMoCAT method, SWNT are grown by CO disproportionate (decomposition into C and CO_2) at 700-950ºC in flow of pure CO at a total pressure that typically ranges from 1 to 10 atm. A process was developed that is able to grow significant amounts of SWNT in less than one hour, keeping selectivity towards SWNT better than 90 percent. We discovered a synergistic effect between Co and Mo that is critical for the performance of the catalyst. The catalyst is effective when both metals are simultaneously present on a silica support with a low Co: Mo: separated, they are unselective shows the selective synthesis of a SWNT using the CoMoCAT method.

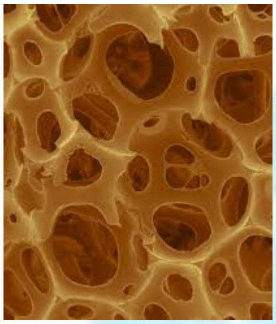


Fig 2 SWNT

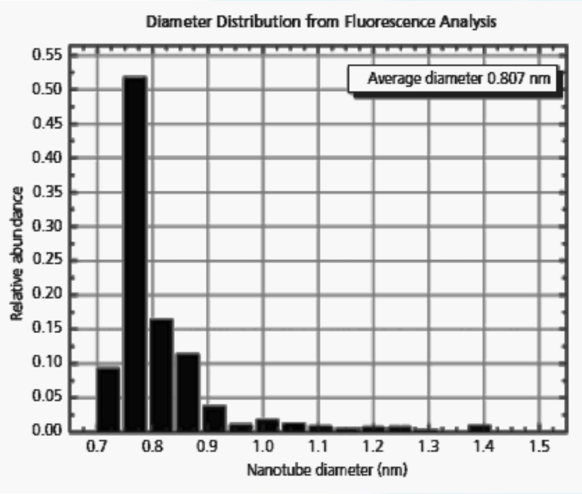


Fig.3 Diameter Distribution from Fluorescence Analysis

The Histogram for SG 65 material shows the very narrow distribution of SWNT diameters possible with the CoMoCAT process. 90% of the tubes have a diameter between 0.72 and 0.92 nm. 52% of the tubes are (6,5) chirality.

Two of the unique characteristics of the CoMoCAT process are that it is readily scalable and its intrinsic high selectivity is preserved as the reactor size is scaled up. These characteristics impart the SWNT product of the CoMoCAT process the dual benefit of low cost and high product quality. This supported catalyst approach also offers the unique ability to provide a substantial degree of chirality control during synthesis. SMPs can retain two or sometimes three shapes, and the transition between those is induced by temperature. In addition to temperature change, the shape change of SMPs can also be triggered by an electric or magnetic field, light or solution. As well as polymers in general, SMPs also cover a wide property-range from stable to biodegradable, from soft to hard, and from elastic to rigid, depending on the structural units that constitute the SMP. SMPs include thermoplastic and thermo set (covalently cross-linked) polymeric materials. SMPs are known to be able to store up to three different shapes in memory. SMPs have demonstrated recoverable strains of above 800%.

2.1 Electro-active SMPs

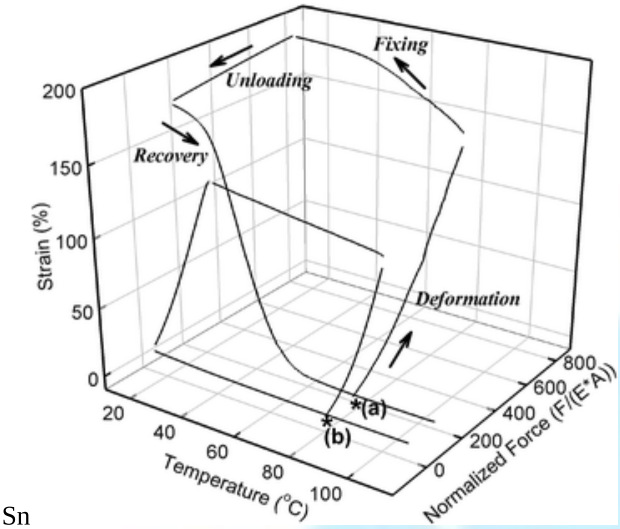
This SMP is used in this project. The use of electricity to activate the shape-memory effect of polymers is desirable for applications where it would not be possible to use heat and is another active area of research. Some current efforts use conducting SMP composites with carbon nanotubes short carbon fibers (SCFs). Carbon black, metallic Ni powder. These conducting SMPs are produced by chemically surface-modifying multi-walled carbon nanotubes (MWNTs) in a mixed solvent of nitric acid and sulfuric acid, with the purpose of improving the interfacial bonding between the polymers and the conductive fillers. The shape-memory effect in these types of SMPs have been shown to be dependent on the filler content and the degree of surface modification of the MWNTs, with the surface modified versions exhibiting good energy conversion efficiency and improved mechanical properties. Another technique being investigated involves the use of surface-modified super-paramagnetic nanoparticles. When introduced into the polymer matrix, remote actuation of shape transitions is possible.

2.1.1 synthesis of shape memory polymers:
Preparation of Poly actide based urethane:

(i)Materials required:

l-lactide, 1,4-Butanediol(BDO) , stannous octate ($Sn(Oct)_2$),Hexamthylene diisocyanate (HDI) , toluene which is dried over Na wire and distilled before use ,Ethyl Acetate which is dried over CaH2 before use.

(ii)Preparation of poly(l-lactide) diol (HO-PLA-OH)
l-lactide was recrystallized in ethyl acetate for three times. It was then added to a glass container which had been flame-dried and equipped with a magnetic stirring bar. A toluene solution of 1,4-Butanediol(BDO) and



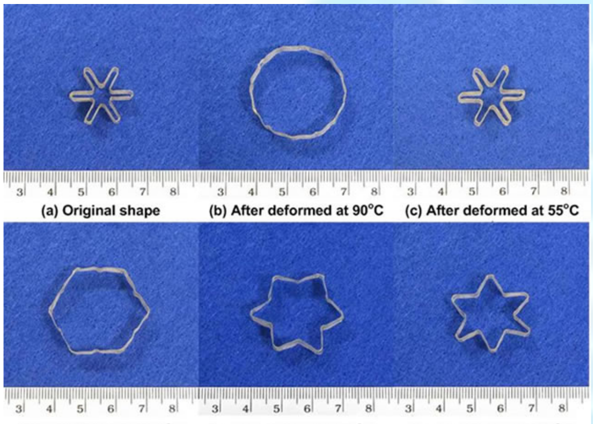

(a) Original shape (b) After deformed at 90°C (c) After deformed at 55°C
(d) After heating to 55°C (e) After heating to 65°C (f) After heating to 80°C

Fig 4 Deformation under loading and unloading

Sn(Oct)$_2$(0.3% of the BDO, mol/mol) was then transferred. An equal amount of toluene was then injected into the container. The reaction vessel was immersed into a thermostatic oil bath maintained at 125 °C for 24 h. The reaction product was precipitated into ethanol, filtered and dried at 40 °C in vacuum for 48 h.

(iii)Preparation of poly (l-lactide) polyurethane (PLAU)

A certain amount of the above prepared poly(l-lactide) diol (PLA diol) was dissolved in double volume of toluene and heated at 75 °C for 20 min. Sn(Oct)$_2$ (1% of the PLA diol, mol/mol) in dried toluene and a given amount of Hexamthylene diisocyanate (HDI) were added to the solution. After stirring for 10 min at 75 °C, 1,4-butanediol (BDO), the mole number of which was equal to the molar difference between HDI and PLA diol, was added and the reaction mixture was stirred for another 6 h. The polymer was isolated by dissolving the reaction mixture in chloroform followed by precipitation in ethanol.

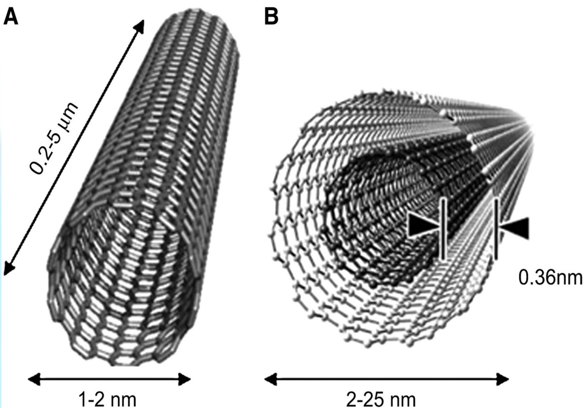


Fig. 5 CARBON NANO TUBE CHICKEN WIRED STRUCTURE

III. ADVANTAGES

According to the statistics published, there is a consumption of about 40 billion liters of gasoline/ year for the usage of air conditioners alone, assuming 80% of vehicles use AC. Even an increase of 0.4 km/liter will save around $6 billion annually.
The results of a study shows that the fuel consumption of the test vehicles with air conditioning systems in operation increases with rising ambient air temperature and humidity, reaching a value of about 18 percent on a typical Swiss summer day with an air temperature of27 degrees and relative humidity of about 60%.

IV. CONCLUSION

Using the CNT sheets in the window pane isfollowed, then around 20 billion liters of fuel can be saved in ayear approximately and the efficiency of the vehicle will have an increase of 5-7% from the normal value.

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