A Review- To Develop the Method for Highly Conductive and Elastic Grapheme/CNT Composite for Wearable Electronics Application

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Abstract - The development of various flexible and stretchable materials has attracted interest for promising applications in biomedical engineering and electronics industries. This interest in wearable electronics, stretchable circuits, and flexible displays has created a demand for stable, easily manufactured, and cheap materials. However, the construction of flexible and elastic electronics, on which commercial electronic components can be mounted through simple and cost-efective processing, remains challenging. We have developed a nanocomposite of carbon nanotubes (CNTs) and polydimethylsiloxane (PDMS) elastomer. To achieve uniform distributions of CNTs within the polymer, an optimized dispersion process was developed using isopropyl alcohol (IPA) and methyl-terminated PDMS in combination with ultrasonication. After vaporizing the IPA, various shapes and sizes can be easily created with the nanocomposite, depending on the mold. The material provides high fexibility, elasticity, and electrical conductivity without requiring a sandwich structure. It is also biocompatible and mechanically stable, as demonstrated by cytotoxicity assays and cyclic strain tests (over 10,000 times). We demonstrate the potential for the healthcare feld through strain sensor, flexible electric circuits, and biopotential measurements such as EEG, ECG, and EMG.This simple and cost-efective fabrication method for CNT/PDMS composites provides a promising process and material for various applications of wearable electronics.

Keywords - Graphene/ Carban nano-tube, Composite, polydimethylsiloxane.

I. INTRODUCTION

Recent progress in wireless communication, Internet of Tings (IoT) devices, and biomedical engineering have enabled

Continuous monitoring of mental and physical health, which is one of the most important issues for ubiquitous healthcare using mobile devices. For such purposeshighly stretchable, flexible, and biocompatible electronics are of great interest. In recent decades, some electronic skin materials have been developed, demonstrating potential applications in would shif flexible electronics to a new technical paradigm. Various nanocomposite materials blending nanomaterials and elastic polymers have recently attracted attention for such flexible electronics. It is well known that carbon based nano-fller, namely, CNTs can improve mechanical properties and electrical and thermal conductivity of polymer composites, due to their extraordinary advantages such as a high aspect ratio, superior elastic modulus, and high conductivity11–15. In addition, low manufacturing cost with mass production make CNTs an ideal candidate fller. Hence, we also considered and used CNTs as a fller in this study. However, producing CNT nano composite materials in viscoelastic polymer solutions is challenging because the CNTs tend to become severely agglomerated. If CNT particles remain heterogeneous, the electrical conductivity can be severely compromised, impeding the use of CNTs for skin-like electronics. Several methods to promote the dispersion of nanoparticles have been developed, including surface modifcation, shear mixing, mechanical agitation, ultrasonic treatment, and ball- or micro-bead milling16–19. For examples, Sekitani et al. 10 reported a fuorinated copolymer/SWNT composite with remarkable properties (a high conductivity of 57 S/cm, elongation up to 134%) using the ionic liquid, and Velasco-Santos et al. 20 incorporated 1-wt% chemically functionalized MWNTs into a polymer matrix by in situ polymerization and reported that the storage modulus increased by 1135% compared to existing similar composites. Fukushima et al. 21 produced CNT/ polymer nanocomposites by the free-radical polymerization of an imidazolium ion-based ionic liquid bearing a methacrylate group to prevent decrease of mechanical modulus as the content of CNTs increased. It is difcult to develop a simple and cost-efective method for homogeneous dispersion of CNTs in a matrix, as well as prevents the reaggregation of dispersed CNTs for extended periods. Furthermore, the mass production of CNT nanocomposite materials with good dispersion in various polymer matrices could become important for extensive applications of stretchable electronics. In this study, we propose a simple, fast, and cost-efective fabrication method for a homogenously hybridized CNT/polydimethylsiloxane (PDMS) composite with high conductivity, stretchability, and fexibility. To our knowledge, the flexible and stretchable digital circuit containing only CNT/PDMS conductive lines and commercial electronic components demonstrated here is the frst of its kind.

II. RELATED WORK

Various researchers have come up with the numerous ideas to create wearable electronics using CNTs. CNT coated cotton yarns is the best example in this regard where insulating yarn is converted into conductor which behaves like flexible and pliable electrode. Sensor based on composite of CNTs and conductive poly(3,4-ethylenedioxythiophene) and poly(styrenesulfonate) is better than the Pt noble metal based sensor. Here we have selected to disperse CNTs into PDMS and IPA as it provides required mechanical stability and conductivity.

III. LITERATURE SURVEY

For various applications in electronics and biomedical engineering flexible and stretchable materials are required. Both CNTs providing necessary conduction and PDMS giving its elastic property can prove to be useful material in this regard. Therefore, it becomes imperative to opt for a cost effective method for fabrication of nanocomposite of CNT/PDMS. Various literature surveys are done in this regard which are as follows:

1. F. Axisa, D. Brosteaux, E. De Leersnyder, F. Bossuyt, J. Vanfleteren , B. Hermans, R. Puers "Biomedical Stretchable Sytems Using Mid Based Stretchable Electronics Technology"atthis work on biomedical stretchable system using mid based stretchable electronics technology and find demonstrated that our technology is ready to provide all the parts for complex implantable stretchable systems or wearable systems, sensors, actuators, power sources. Waveguides and antennas are also under development. Those demonstrators are a toolbox for the development of different systems. Multilayer systems, capacitive pressure sensors, integration of polymer artificial muscle in stretchable matrices, very high density stretchable electrodes, stretchable microfluidics, stretchable displays, 3D shaped systems are thenext steps for this technology.

2.Minwoo Park, Jungkyun Im, Minkwan Shin, Yuho Min, Jaeyoon Park," Highly stretchable electric circuits from a composite material of silver nanoparticles and elastomeric fibres"at al work on Highly stretchable electric circuits from a composite material of silver nanoparticles and elastomeric fibres and conclude that Conductive electrodes and electric circuits that can remain active and electrically stable under large mechanical deformations are highly desirable for applications such as flexible displays, field-effect transistors, energy-related devices smart clothing and actuators. However, high conductivity and stretch ability seem to bemutually exclusive parameters. The most promising solution to this problem has been to use one-dimensional nanostructures such as carbon nanotubes and metal nanowires coated on stretchable fabric metal stripes with a wavy geometry composite elastomers embedding conductive fillers and interpenetrating networks of a liquid metal and rubber. At present, the conductivity values at large strains remain too low to satisfy requirements for practical applications. Moreover, the ability to make arbitrary patterns over large areas is also desirable. Here, we introduce a conductive composite mat of silver nanoparticles and rubber fibres that allows the formation of highly stretchable circuits through a fabrication process that is compatible with any substrate and scalable for large-area applications. A silver nanoparticle precursor is absorbed in electro spun poly (styrene-block-butadiene-block-styrene) (SBS) rubber fibres and then converted into silver nanoparticles directly in the fibre mat. Percolation of the silver nanoparticles inside the fibres leads to a high bulk conductivity, which is preserved at large deformations (s ≈ 2,200 S cm–1 at 100% strain for a 150-mm-thick mat). We design electric circuits directly on the electro spun fibre mat by nozzle printing, inkjet printing and spray printing of the precursor solution and fabricate a highly stretchable antenna, a strain sensor and a highly stretchable light-emitting diode as examples of applications.

3. Dong-Ming Sun , Chang Liu , Wen-Cai Ren , and Hui-Ming Cheng," A Review of Carbon Nanotube- and Graphene-Based Flexible Thin-Film Transistors"Work on and conclude that Carbon Nanotube- and Graphene-Based Flexible Thin-Film Transistors Flexible thin-fi lm transistors are aimed at new style electronics thatcould possibly change many aspects of our life. Such electronic devices must be achieved by low-cost, fast and high-yield fabrication processes different from the conventional rigid silicon electronics. CNTs and graphene have been receiving tremendous attention for application in flexible electronics because they are technically superior in terms of carrier mobility and chemical stability in thin-fi lm transistors to any other semiconducting materials, such as organic semiconductors. This review summarized the progress of flexible CNT- and graphene-based thin-fi lm transistors from material preparation, device fabrication technique to transistor performance control. We have attempted to clarify feasible approaches which will most likely lead to the realistic production of flexible electronics in the future, because not all approaches among the huge number of reports have a scale-up possibility in industrial development.

IV. PROPOSED METHOD

The flow chart of our proposed model is shown in fig. 1. After reading of that paper we propose a simple, fast, and cost-effective fabrication method for a homogenously hybridized CNT/polydimethylsiloxane (PDMS) composite with high conductivity, stretch ability, and flexibility.

Flow diagram

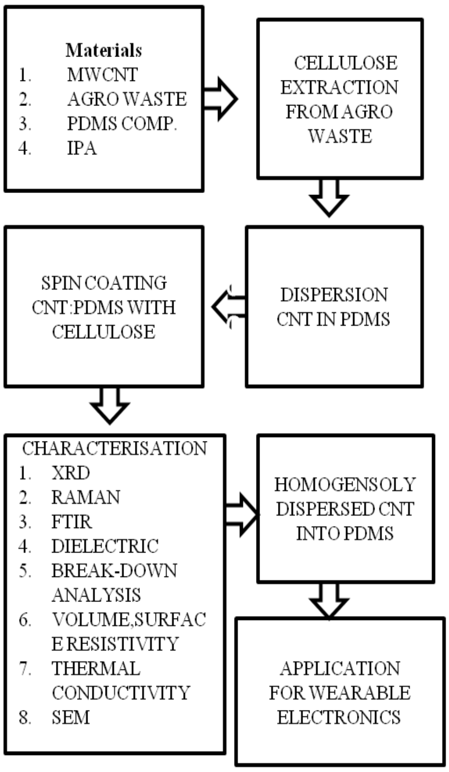

Fig.1. proposed flow diagram

Where materials are used to my proposed research work.

1. Multi-walled carbon nanotubes (MWCNTs, CM-95, >95.0%, 10–20-nm outer diameter, 10–20-μm length). Agro Waste, PDMS components, IPA and other organic solvents.

2. Cellulose will be extracted from Agro-Waste.

3. CNT will be dispersed in PDMS

4. Spin coating of CNT: PDMS with cellulose on flexible substrate.

5. Pristine MWCNTs will be first dispersed in IPA with a 100:1 weight ratio and ultrasonicated for 30 min to obtain single CNTs dispersed in excess IPA solution. Then, 20-wt% low-viscosity (100cSt) silicone fluid (MEP) will be added to the dispersion and ultrasonicated for 10 min. To obtain a homogeneous dispersion, 80 wt% of PDMS-A will be added and ultrasonicated for 10 min. After it IPA will evaporated the cross linker PDMS-B will be added and vigorously mixed. Vacuum desiccators will be used to remove the bubbles remaining from the mixing process. The blend will be cast in a mould and cured in an oven for 2 h at 80 °C.

V. SYSTEM MODEL/INSTRUMENT USED

Characterization of CNT/PDMS Nano-composites

I. XRD analysis to determine the phase of the sample.

II. SEM analysis for detailed morphologic analysis.

III. Raman spectrometry analysis.

IV.Fourier Transform Infrared Spectroscopy (FTIR) analysis

V.Dielectric analysis of the flexible CNT: PDMS film.

VI. Temperature depended dielectric analysis.

VII. Analysis volume/surface resistivity.

VIII. Thermal Conductivity Analysis.

VI. APPLICATION OF THE CNT/PDMS COMPOSITE.

Flexible electronic circuit. We made metal-free flexible circuits comprising PDMS substrates and the CNT/PDMS nanocomposite, as shown in Electrical coupling (mounting) between a metal and a polymer has many difficulties, and many studies are ongoing to solve this problem. Our study solved this problem simply by inserting the electric components into the CNT/PDMS line when producing the flexible electronic circuit,. The connection between the electronic components and the CNT/PDMS composite had no problem with the operation of a flexible electronic circuit bent on top of the finger.

Strain sensor. The CNT/PDMS composite was then tested as a strain sensor. The U-shaped strain sensor with wires connected on one side was attached to the joint of a forefinger. The change in the resistance is recorded with a millimetre when the finger is bent to angles of 30, 60, and 90°. When the nanocomposite is stretched under a tensile strain, the interconnections and spacing among the CNTs are changed.

VII. CONCLUSIONS

In this paper which is based on the experimental result shows a new approach to We have developed an efficient and effective system for creating highly homogeneous dispersions of CNT nano- composite materials in PDMS elastomers: our proposed method is simple fast and cost-effective Curing the elastomer creates a highly conductive and stretchable material with sensitive properties for wearable electronic applications

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