Carbon Nanotube Sensors for Synthetic Skin

Hamish Colenso

December 2015

Abstract

Hello World.

1 Introduction

1.1 Orthotic Rehabilitation

1.2 Carbon Nanotubes

1.3 something something something

2 Method

Device creation is split into subprocesses which are described in more detail below. The basic premise of the device creation is to produce a flexible substrate, deposit contacts onto this substrate, deposit the sensor material onto the substrate, repeat the process, cover one device with a deformable dielectric, sandwich the two layers together and finally encapsulate the device in a protective outer coating.

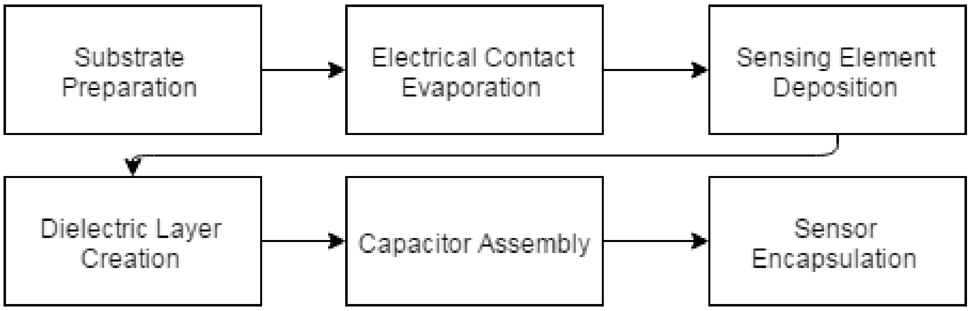

Figure 1: The process for creating a capacitive sensor device

2.1 Preparation

1. Cut slides
2. Mix PDMS 10:1 base to curing agent ratio
3. Pour 12 ml PDMS into petri dish covered in slides
4. Leave to set
5. Cut individual slides away
6. Flip PDMS over to reveal smooth surface from glass slide

2.2 Evaporation

1. Kapton tape samples to sample holder, leave 1-2 mm for contacts on either edge of the sample
2. Load samples into evaporate and pump down evaporator
3. Deposit 5 nm of Cr
4. Deposit 75 nm of Au
5. Contacts formed bring evaporator back to room pressure to remove samples

2.3 CNT Deposition

1. Set Hotplate to 150^oC
2. Mix a tiny concentration of CNTs (less than a pinch on the end of the spatula) with 10-12 ml NMP
3. Sonicate CNTs @ 40^oC for 2 hours
4. Load samples into sample holder on hotplate
5. Set Air Pressure on Airbrush to 2 Bar
6. Test AirBrush with some IPA
7. Spray CNT solution using the airbrush, wait for NMP to evaporate from the sample between sprays
8. Spray NMP:CNT solution and check conductivity of film once NMP has evaporated

2.4 Optional ILL

2.5 Optional RIE

2.6 Dielectric Layer

2.7 Device Encapsulation

3 Results

1. Capacitive sensors for strain and touch applications
   This should show that it is possible to both compress the sensor, that is change the dielectric thickness for a response. It also should show that it is possible to stretch the sensor, both compressing the dielectric thickness and decreasing the plate coverage area. The devices should be able to withstand 200% strain and decent compressive forces.

2. $^{\Omega}/_{\square}$ film characterisation
   This should show that the gauge factor increases as we approach sensor destruction during stretch events. So we have a trade off between a sensor that is reliable and a sensor that provides the performance characteristics required for mobile applications.

3. Overshoot removal and power improvements
   This should show that the capacitive sensors remove overshoot when compared to resistive sensors, and that the dielectric leakage from the devices is much less than the resistive sensors. This will indicate the sensors have improved power consumption performance for mobile applications when compared to the resistive devices

4 Evaluation

4.1 Comparison to objectives for orthotic rehabilitation

5 Conclusion

5.1 Indicative results indicate the potentional for this to be applied to rehabilitation devices