Flexible Electronics

Student(s)
Alper Bayraktaroğlu
Ekrem Yüksel

Faculty Member(s)
Murat Kaya Yapıcı

Sabancı Üniversitesi

PURE
PROGRAM FOR UNDERGRADUATE RESEARCH

ABSTRACT

Classical Ag/AgCl electrodes measures heart rate by measuring electrical activity (ECG). These electrodes are attached to naked skin and used with gel to increase the conductivity. However in long term usage this gel dries and irritates the skin, which causes loss in data. With flexible electronics these harms are reduced and more consistent data of pulse can be collected. Moreover this method provides cheaper production with mass-production. In this project we tried to create conductive pattern on textile. The pattern we used is serpentine shaped pattern that would mimic resistance of a circuit. When textile gets stretched and/or flexed the resistance within the pattern will change. Thus we will able to measure pulses from our wrists and/or necks.

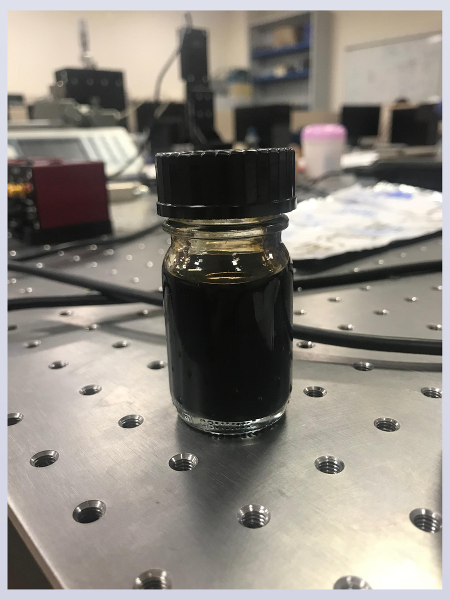

Figure 1: Conductive ink (Graphene-Oxide)

Figure 2:

OBJECTIVES

- Forming a certain conductive pattern with the conductive ink (Graphene Oxide /GO) by
  - Utilizing syringe pump and micromanipulator
  - Treating surface
  - Building passive circuit elements and interconnects on a flexible textile surface
- Measuring pulses from wrist via resistance changes in pattern.

FORMING THE PATTERN

Figure 3: Syringe Pump

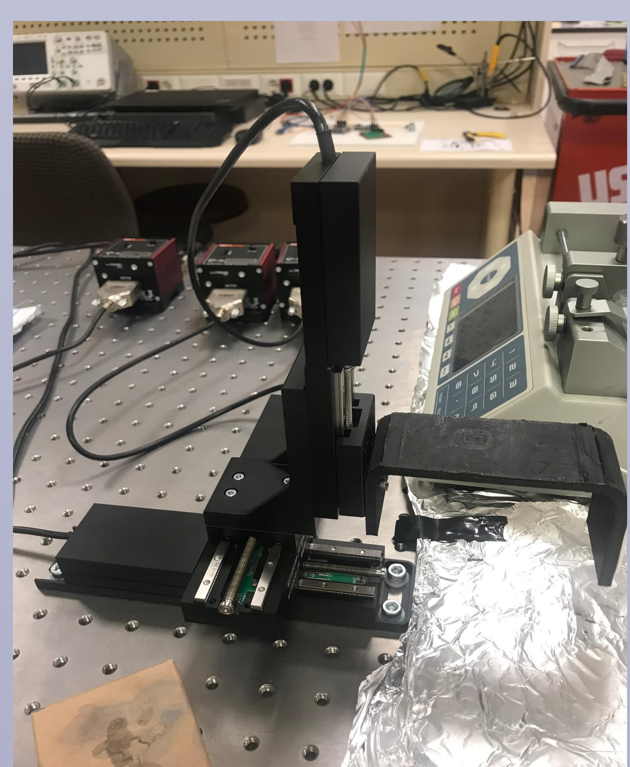

Figure 4: Micromanipulator

To form a certain conductive pattern, appliance of the ink and the surface of textile should be optimized. A setup is made: a syringe connected to syringe pump and fastened to the 3D-printed plastic piece which also attached to the micromanipulator. With syringe pump, flow rate and volume of conductive ink can be controlled and with micromanipulator, desired spot or path which ink will be dropped can be determined. We prepared 4 different pattern models with different width/length ratios to calculate resistance differences and ensure whether the resistance values are consistent or not.

SURFACE TREATMENT

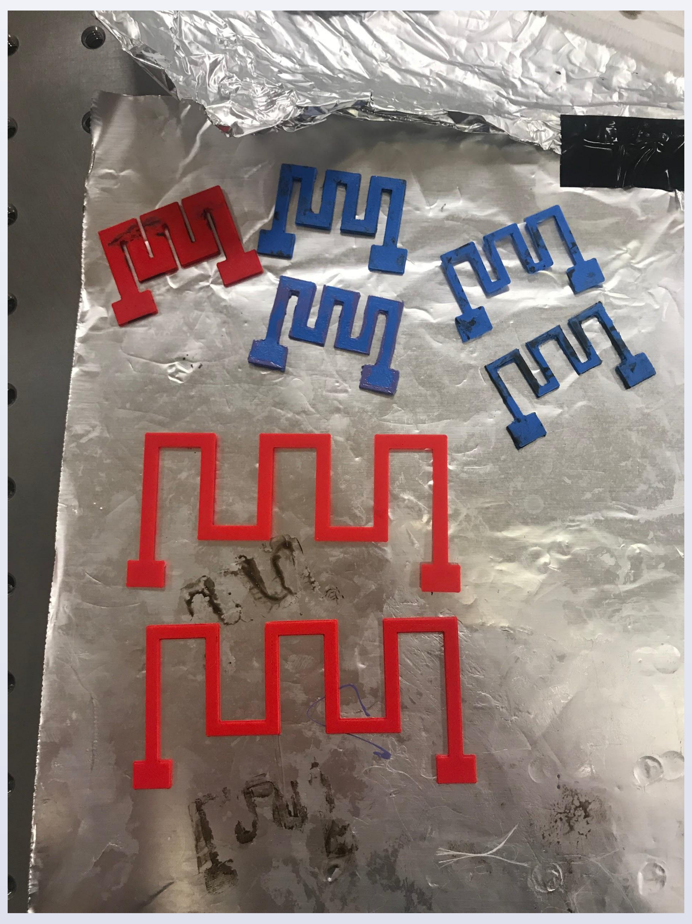

Figure 5: 3D-printed plastics

Figure 6: Test Structures

To ensure the conductive ink stays within the pattern, not spread out, surface should be optimized. We did our first tests with liquid dye and used Vaseline, hydrophobic spray, nail polish to coat the textile to make some areas hydrophobic. 3D-printed plastics are used to mask the pattern area when coating materials are applied such as Vaseline.

Figure 7: GO to rGO reactions

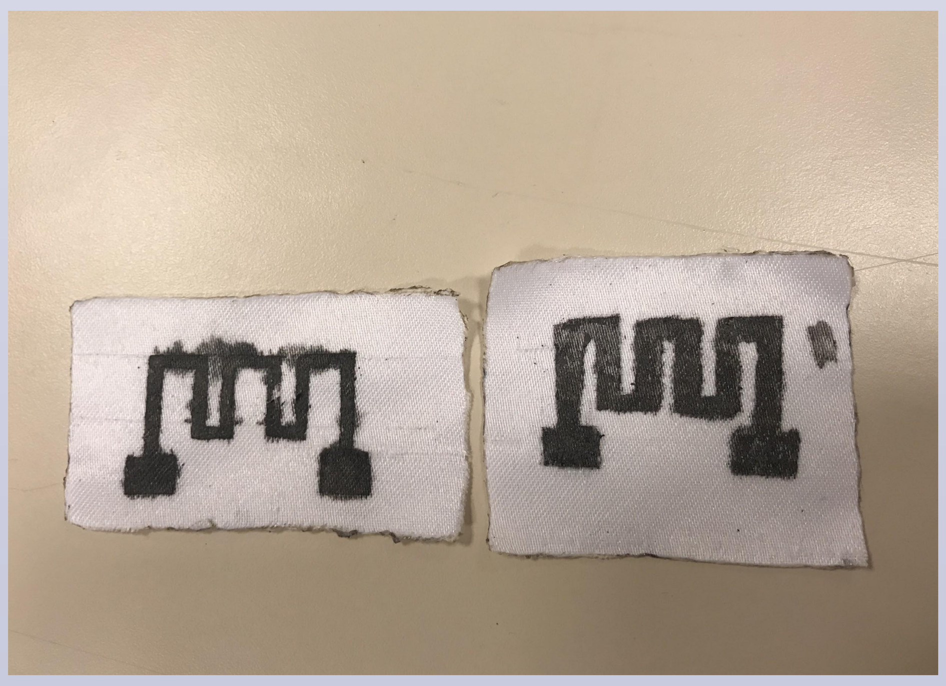

Figure 8: Test Structures with rGO

We had decent results with this method but when we proceeded with graphene oxide, we observed GO has different characteristics like viscosity from the liquid dye. GO was denser than the ink. Therefore we changed our method and taped the whole fabric except the pattern area. Then dropped the GO on the pattern area and pressed the 3D-printed pattern-shaped plastic on the pattern area for better and more homogeneous diffused GO on the fabric. After removing the tapes, some chemical processes had made and GO on the fabric reduced to the Reduced Graphene-Oxide (rGO) to make the pattern conductive. Finally we had the precise conductive pattern with the conductive ink.

CONCLUSIONS

Low-cost flexible e-textiles can be made with different methods and materials like graphene-oxide. By virtue of forming conductive patterns, there will be no need to additional wires for interconnects in flexible electronics. With development of this technology, low-cost flexible wrist bands can be manufactured. Furthermore, these e-textiles can be used in many fields such as military medicine and more.

ACKNOWLEDGEMENTS

This research was supported by the PURE-2018 program at Sabanci University.
We thank Gizem Acar and Özberk Öztürk for their help during different stages of the project.

REFERENCES

•M. K. Yapici and T. E. Alkhidir, "Intelligent medical garments with graphene-functionalized smart-cloth ECG sensors," Sensors, vol. 17, no. 875, 2017.