Increased Sustainability & Flexibility using Organic Dielectric & Gate on Printed Circuits

Zameer Karim karim013@cougars.csusm.edu & Jonathan Nuñez nunez121@cougars.csusm.edu
Advisor: Dr. Reza Kamali-Sarvestani, Ph. D. (rkamali@csusm.edu)
Department of Electrical Engineering at California State University, San Marcos

Flexible electronics are currently in high demand and have been predicted to increase from a few billion-dollar global market earlier this decade, to a $60 billion-dollar industry by this year.[1] Flexible electronic circuits are ones that can be stretched, bent, compressed, or undergo other types of deformation while still maintaining their ability to flow current like that of a standard, rigid substrate. The use of certain inorganic materials, such as silicone, which is currently utilized in printed circuits is not favorable, due to its limited flexibility and brittleness, and instead another substrate must be found to accommodate the changing trend from rigid to flexible circuits.[2] These new flexible electronic circuits have a myriad of available implementations including use in roll-up displays, foldable cell phones, prosthetics, as well as other healthcare, environmental and even military applications.[3]

Instead of using silicone for the substrate of a transistor as is traditionally done, graphene, which is a single atomic layer of graphite, can be used instead as a thin-film field effect transistor (TFT) semiconductor, due to its inherent flexibility and resistance to cracking like silicone does, as well as its greater chemical and thermal stability.[4] In addition, graphene has the capability of moving higher number of electrons, as well as possessing the advantage of both a higher tensile strength and greater flexibility than its traditional counterpart.[5] A popular method of creating flexible electronic circuits is through the use of printing, as the additive process is inherently more environmentally friendly than the subtractive chemical process that is currently utilized, due to a reduced cost and less waste than is traditionally associated with Printed Circuit Boards (PCBs).[6] Upon testing of potential capabilities, it was determined that smoother substrates have an increased likelihood of maintaining the graphene that is printed upon them, with traditional porous printer paper being less desirable than high gloss photo paper in this instance.[7]

In addition to the use of graphene, it has been shown that dielectric gels have promising potential in the construction of flexible gates, because they are able to maintain their performance under compression, stretching and other deformation. However, the use of synthetic dielectric gels is not as favorable as using organic, renewable, environmentally friendly, and otherwise sustainable materials. An organic material that maintains a similar viscosity to that of traditional synthetic dielectric gels is honey. Honey has already been shown in experiments to be a feasible substitute for traditional synthetic dielectric gels in the prototyping of Graphene based transistors.[8] We propose to explore the potential uses further and to test the theoretical probability of the applications usefulness to see if this is a sustainable possibility for widespread adoption in printed electronic circuits in the future.

References

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