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A Study of Graphene Ink in Fine Solid Lines Printed by Micro-flexographic Printing Process for Electronic Industry

Abstract:
Graphene had a good potential as printing ink in producing micro to nano solid lines printing capability for the application of printing electronic, graphic and bio-medical [1]. This study elaborated the application of graphene as a printing ink use in combination of flexography and micro-contact printing technique which known as Micro-flexographic printing for micro fine solid lines. The Micro-flexographic printing technique will assist toward printed micro to nano scale of RFID (Radio Frequency Identification) antenna and Organic Field Effect Transistor (OFET) which will be used in many sectors for example in electronic devices, biomedical application, security and etc. The interest of RFID technology met the emerging demands in the automation process [2]. These RFID components demonstrated by this technology in relation to other existing identification systems as shown in Figure 1. Another application in printing electronic was OFET liked showing in Figure 2. It gave consistency and homogeneous ink layers in printing process. Hence, this study will put a step forward looking the roll to roll printing process which was vital prior to print any functional materials on thin film or other substrates layered. Organic transistors were stilled in development process stage and their performance cannot be competed with traditional semi-conductor transistors. The wettability and incompatibilities has to be overcome where a smooth and homogeneous interface is crucial for the OFET performance [3]. In aspect of biomedical application, cell culturing could be printed in low cost with higher throughput. This printing method could avoid the use of batteries and wires connection which decreased the overall size of the biomedical device. During printing experimental process, graphene was used a printing ink medium to print the fine solid lines image on biaxially oriented polypropylene (BOPP) thin film substrate. Graphene was a pure carbon with one atom thick and nearly transparent. Graphene material could be exposed in a lot of application but it stilled not commercially used in printing industry. Graphene had high thermal conductivity which suitable for super capacitors fabrication [4]. Several printing trial had been done by using laboratory Micro-flexographic printing machine which was combination of flexography and micro-contact printing technique [5]. The printing plate with 3 µm fine solid lines image for lines width and gap was used in this experiment work. It was made by polydimethylsiloxane (PDMS) material. The material property of PDMS liked deformation was suitable to use in Micro-flexographic printing method. This research was successfully produced graphene fine solid lines with 2.7 µm width and the line height at 1 µm liked showing in Figure 3. The graphene line image was captured by using D 3100 AFM. The results also showed the surface roughness, Ra was 20 nm. The graphene fine solid lines printed image development was a continuous process in improving the printing technique. The achievement was very important for high speed micro to nano technology printing not only in electronic industry but also for graphic and bio-medical purpose with less waste, simple, rapid, low cost method and roll to roll capability.

Figures

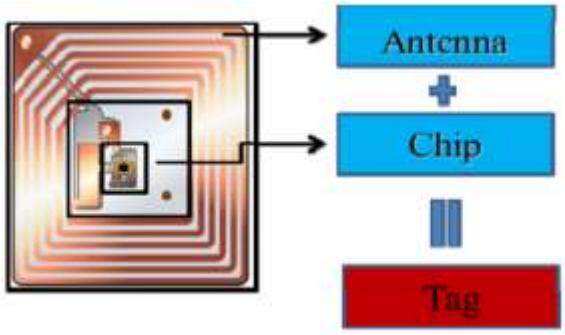

Figure 1: RFID tags component [2]

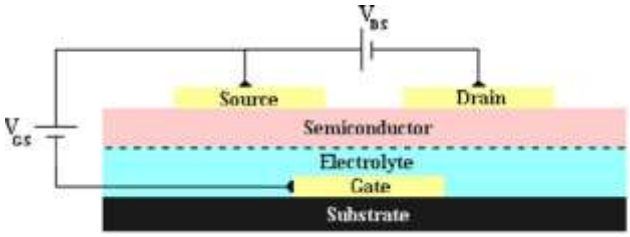

Figure 2: OFET design structure [3]

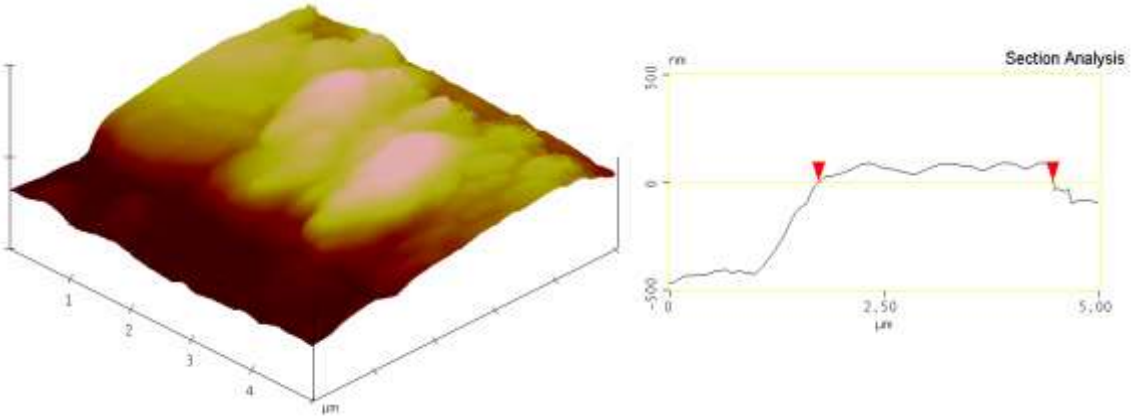

Figure 3: 3D image of graphene fine solid line and section analysis

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