

Flexible Electronics: Printing Technologies and Its Applications

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Abstract: Flexible electronics is a technology of assembling electronic circuits by mounting electronic devices on flexible plastic substrates. This technology is used in electronic devices which can be bent and stretched into any shape at any time. These devices play a major role in displays and human machine interaction with sensors. This paper presents various printing technologies commonly used in fabrication of electronic devices on nonconventional substrate. The applications of these electronic devices are discussed.

Key Words - Flexible electronics, Sensors, Printing, Fabrication, Substrates, Flexible lighting, Consumer electronics.

I. INTRODUCTION

In recent years, flexible electronic devices have received tremendous attention due to their ruggedness, portability, light-weight, and low-cost of production as compared to rigid substrates. The ability of these devices to curve, roll, flex, conform and fold, enables a new intuitive user interface and hence the technology is adopted in entertainment and gaming industry.



Fig 1: Flexible printed electronic circuit

The flexible electronics technology covers a range of new modalities from paper documents to newest smartphones.



Fig 2: Flexible electronics technology

In the fabrication process of these electronic devices, the materials that exhibits the functionalities of insulator, conductor, semiconductor are used as ink and is sprayed on the plastic substrate as a thin film or patterns with various printing technologies. Our present research tells how these circuits are printed on the plastic substrate and the methods involving in it. It also provides an overview of flexible electronic devices and their applications and adoption of different flexible electronic circuits with low cost and advancement.

II. PRINTING METHODOLOGIES

Wafer based printing technology is used for fabrication of flexible electronic circuits. Based on the mechanism used to spray the ink on the plastic substrate, printing technologies are classified as 1. Contact printing 2. Non-contact printing.

2.1 Contact Printing

In contact printing, ink is deposited on the pattern to be printed and brought in contact with the target(plastic) substrate. The contact printing technologies are Screen Printing, Gravure Printing, Offset Printing, Flexographic Printing, Micro-Contact Printing, Nano-imprinting, Dry Transfer Printing.

2.2 Non-Contact Printing

In Non-Contact printing, the ink is passed through the openings or nozzles on the structures defined in a pre-programmed pattern by moving substrate holder.

The Non-contact printing technologies are Inkjet Printing, Slot-die Printing, Electrohydrodynamic Printing.

Inkjet Printing is further classified as CIJ (Continuous Ink Jet) and DoD (Drop on Demand).

The Non-Contact printing technology has greater attraction because of speed, reducible waste, simplicity and affordability.

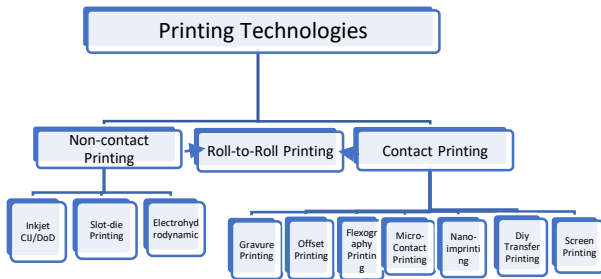


Fig 3: Classification of Printing Technologies

III. LITERATURE

A few review articles reported in this field previously have reviewed some of printing technologies individually. For example, the review papers by

1. inkjet printing was focused by Singh [1]
2. Nano-imprinting was focused by Schiff [3]
3. Transfer printing was focused by Carlson [4].
4. Perl et al. [2] has presented a review on Micro-contact printing.
5. Sondergaard et al. [5] discussed Roll-to-Roll (R2R) fabrication.

IV. APPLICATIONS

Flexible circuits also known as Flex circuits are often used as connectors in various applications where flexibility, space saving or production constraints limit the serviceability of rigid circuit boards.



Fig 4: Applications of Flexible electronics

Computer keyboards uses flex circuits for switch matrix. Flex circuits are used in industrial and medical devices where many interconnections are required in a compact package. Cellular telephones are another example of flex circuit.

Flexible electronics plays an important role in health care. whether it is sensors, wearables or other products the flexible nature of the technology lends itself to the human body. For example, bionic ear, eye, optic nerve etc. are flex devices integrated in human body.

The next generation flexible electronics open up a wide range of exciting new applications such as flexible lighting and display technologies for consumer electronics, architecture, textiles, implantable electronics for improved medical imaging and diagnostics.

This technology is also used in extending the functionality of robots and unmanned aircraft to light weight and conformable energy harvesting devices and sensors.

V. CONCLUSION

In this paper, we provided an overview of various fabrication techniques, applications and properties of flexible electronics like low weight, low cost, flexibility, durability which enhances the performance of these devices. It also provides an idea about the future scope of flexible electronics in healthcare, consumer electronics.

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