

## Introduction for JEP Special Issue on Printed Electronics

Recent trends in microelectronics converge to flexible, stretchable, rollable, bendable, and wearable components or devices for a variety of applications such as displays, portable devices, energy generation/storage devices, etc. Printed electronics is emerging as one of the technology enablers for such flexible devices.

While the use of metal movable-type printing was first invented in Asia as early as the 13th century, the western-style printing press was not fully adopted until centuries later. Since then, printing technologies have evolved dramatically, including recently developed direct printing methodologies such as ink jet printing. Recent advances in three-dimensional printing technologies offer myriad new possibilities. Three-dimensional fabrication via additive manufacturing is becoming a powerful tool not only for prototyping but also for mass production of commercial devices.

During the last ten years or so, extensive efforts have been invested in developing printed electronics. Although the printing technologies have evolved dramatically, there are still many technical challenges for high performance and low cost printed electronics. Key technology barriers include limited material properties. In an effort to synthesize recent developments in these areas and to assess the state-of-the-art of our fundamental understanding of the scientific issues involved, we invited a group of researchers who have been actively involved in the research and development of printed electronics to submit their articles for the special issue of *Journal of Electronic Packaging*. After carefully reviewing all the submissions following the standard review practice for regular JEP papers, we have accepted 11 articles for this special issue.

These articles address a variety of topics, including printing materials (water-based carbon nanotube inks, silver nanoparticles, low melting temperature metal alloys, etc.), device applications (gas sensors, memory devices, stretchable sensors, etc.), computational and statistic modeling, standardization of the direct writing material and technology, etc. Efforts are made to focus on experimental and analytical approaches of printed materials and processes. Recent advances in direct printing and standardization of the direct writing material and technology are covered in selected

articles. Since metal nanoparticles as conduction paths or interconnects and nanocarbon materials as a sensing material are major functional components in printable materials, their syntheses and applications at the device level are presented as well.

Although a wide range of topics are touched upon, it is not possible to cover the entire field of printing electronics in a single journal issue. No attempt was made to make it a comprehensive review either. Instead, we hope that this special issue presents the readers with a snapshot of the recent trends in printed electronics. We are confident that these papers will generate and stimulate more discussions and, consequently, more innovations and technology advances in printed electronics to open a new era of future flexible microelectronics and photonics.

Finally, we would like to express our deepest gratitude to all the contributors of this special issue for their support and cooperation, and to the JEP editor-in-chief for giving us the opportunity to edit a special issue on very timely topics.

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