2-dimensional Material Inks for Additive Electronics Manufacturing of Planar and Conformal Optoelectronics

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Recent advances in the synthesis of 2-dimensional (2D) materials-based inks has increased the design space for additive electronics manufacturing for sensors, 2D-silicon integrated photonics, energy harvesting and storage, and more. In particular, the Advanced Nanomaterials and Manufacturing Laboratory at Boise State University has undertaken several projects to help overcome obstacles facing the integration of 2D materials in applications for energy, healthcare, and water. This talk will highlight results of several ongoing studies on the development of 2D and layered materials inks for materials jetting platforms such as inkjet printing (IJP), aerosol jet printing (AJP), and plasma jet printing (PJP). These tools are promising technologies for direct deposition of functional 2D and layered nanomaterials. Such printers have significant advantages over standard microfabrication techniques, including low cost, noncontact printing, rapid prototyping, and compatibility with roll-to-roll production of electronic devices and sensors on flexible substrates. However, formulating stable inks which can meet the various rheological requirements of these various platforms can be quite challenging. Here we present recent developments in 2D and layered nanomaterial inks including black phosphorus [1], transition metal dichalcogenide alloys, Bi_2Te_3 thermoelectric [2], and MXene [3] based inks for a variety of additive electronics manufacturing applications. Such multifunctional material inks highlight a new dimension for research on next-generation printing of electronic devices such as low-cost sensors, energy conversion and storage devices, and microscale electronics.

References

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Figures

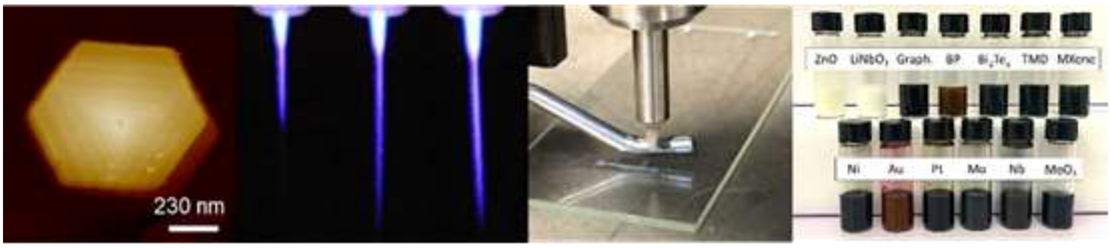

Figure 1: Examples of inks and printers for direct writing of electronics. Left to right shows thermoelectric flakes, plasma jet printing, aerosol jet printing, and library of developed inks.