

Inkjet Printed MoS₂ Electronics

Keshav Sharma, Pei He, Mark Bissett, and Brian Derby, University of Manchester (UK)

ABSTRACT

Inkjet printing of two-dimensional (2D) layered materials has attracted a substantial interest for emerging electronic applications. Layered Metal dichalcogenide (LMDC) molybdenum disulphide (MoS₂) is seen as a new age 2D material beyond graphene, owing to its novel electronic and optical properties, which opens up a wide range of applications. Liquid phase exfoliation (LPE) is a promising technique to produce high yield and stable dispersions of 2D materials for printing purposes. A number of strategies have emerged to produce inks and printing methods for electronic device performance, including: tailoring the surface energy and viscosity of the ink or using different substrate surface treatments prior to printing. Here we demonstrate inkjet printing as a viable large area method for MoS₂ based device fabrication. We

have developed a LPE MoS₂ based ink using a mixed IPA/water (7:1) solvent. This produces MoS₂ inks with concentration up to 1.5mg/ml and a MoS₂ flake size distribution from 200-500 nm with thickness ranging from monolayer to few layers. Surface tension and viscosity studies were conducted to examine the printability of the ink. Substrate surface modification treatments including O₂ etching and hexamethyldisilazane (HMDS) has been applied to aid the printing process. AFM and SEM characterization were used to show that thin films produced by inkjet printing were uniform and continuous. MoS₂ traces were printed on silicon substrate to produce thin film transistors. Conductivity as a function of film thickness was measured for bare substrate, HMDS treated substrate and O₂ treated substrate. Output and transfer characteristics of inkjet printed thin film transistors were measured which shows a promising development.