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Inorganic Printable Materials for Printed Electronics: TFT and Photovoltaic Application

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Printed electronics based on the direct writing of solution processable functional materials have been of paramount interest and importance. In this talk, the synthesis of printable inorganic functional materials (conductors and semiconductors) for thin-film transistors (TFTs) and photovoltaic devices, device fabrication based on a printing technique, and specific characteristics of devices are presented. For printable conductor materials, Ag ink is designed to achieve the long-term dispersion stability and good adhesion property on a glass substrate, and Cu ink is sophisticatedly formulated to endow the oxidation stability in air and even aqueous solvent system. The both inks were successfully printed onto either polymer or glass substrate, exhibiting the superior conductivity comparable to that of bulk one. In addition, the organic thin-film transistor based on the printed metal source/drain electrode exhibits the electrical performance comparable to that of a transistor based on a vacuum deposited Au electrode. For printable amorphous oxide semiconductors (AOSs), I introduce the noble ways to resolve the critical problems, a high processing temperature above 400°C and low mobility of AOSs annealed at a low temperature below 400°C. The dependency of TFT performances on the chemical structure of AOSs is compared and contrasted to clarify which factor should be considered to realize the low temperature annealed, high performance AOSs. For photovoltaic application, CI(G)S nanoparticle ink for solution processable high performance solar cells is presented. By overcoming the critical drawbacks of conventional solution processed CI(G)S absorber layers, the device quality dense CI(G)S layer is obtained, affording 7.3% efficiency CI(G)S photovoltaic device.

Keywords: Inorganic, Printable, Printed Electronics, TFT, Photovoltaic

SA-2

Rheological Perspectives on Direct Printing Processes

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With recent advances in materials and products, materials processing experiences new challenges. More particles and polymers in material side and thinner and faster deformations in processing side. It happens in most emergying industries such as manufacturing of batteries, solar cells, multi-layer chips, displays, printed electronics, to list a few. In most cases, they are manufactured by coating or printing process, which is defined as a process in which gas is replaced by liquid on a substrate. In this sense, casting, inkjet printing, and roll-to-roll printing are all included. The printing process consists of three unit processes. As the materials used in the above mentioned applications typically contain a large amount of particles with polymers and solvents, they continuously change microstructures during preparation, flow, and even drying. However, little is known about the flow characteristics of such complex fluids and less is known about how to design and control the process. Therefore, for better control of the process and for better quality of the product, we need to understand the flow characteristics of these complex fluids under extremely fast flow environment.

Keywords: Rheology, Slurry, Paste, Processing