SA-6

Direct Transfer Printing of Nanomaterials for Future Flexible Electronics

이태윤†

연세대학교 전기전자공학부
(taeyoon.lee@yonsei.ac.kr†)

Over the past decade, the major efforts for lowering the cost of electronics has been devoted to increasing the packaging efficiency of the integrated circuits (ICs), which is defined by the ratio of all devices on system-level board compared to the area of the board, and to working on a larger but cheaper substrates. Especially, in flexible electronics, the latter has been the favorable way along with using novel nanomaterials that have excellent mechanical flexibility and electrical properties as active channel materials and conductive films. Here, the tool for achieving large area patterning is by printing methods. Although diverse printing methods have been investigated to produce highly-aligned structures of the nanomaterials with desired patterns, many require laborious processes that need to be further optimized for practical applications, showing a clear limit to the design of the nanomaterial patterns in a large scale assembly. Here, we demonstrate the alignment of highly ordered and dense silicon (Si) NW arrays to anisotropically etched micro-engraved structures using a simple evaporation process. During evaporation, entropic attraction combined with the internal flow of the NW solution induced the alignment of NWs at the corners of pre-defined structures. The assembly characteristics of the NWs were highly dependent on the polarity of the NW solutions. After complete evaporation, the aligned NW arrays were subsequently transferred onto a flexible substrate with 95% selectivity using a direct gravure printing technique. As proof-of-concept, flexible back-gated NW field effect transistors (FETs) were fabricated. The fabricated FETs had an effective hole mobility of 0.17 cm2/V・s and an on/off ratio of ∼1.4×104. These results demonstrate that our NW gravure printing technique is a simple and effective method that can be used to fabricate high-performance flexible electronics based on inorganic materials.

Keywords: Transfer printing, Nanowire, Entropic force, Gravure printing

SA-7

Micro to Nano-scale Electrohydrodynamic Nano-Inkjet Printing for Printed Electronics: Fundamentals and Solar Cell Applications

변도영†

건국대학교
(dybyun@konkuk.ac.kr†)

In recent years, inkjet printing technology has received significant attention as a micro/nanofabrication technique for flexible printing of electronic circuits and solar cells, as well for biomaterial patterning. It eliminates the need for physical masks, causes fewer environment problems, lowers fabrication costs, and offers good layer-to-layer registration. To fulfill the requirements for use in the above applications, however, the inkjet system must meet certain criteria such as high frequency jetting, uniform droplet size, high density nozzle array, etc. Existing inkjet devices are either based on thermal bubbles or piezoelectric pumping; they have several drawbacks for flexible printing. For instance, thermal bubble jetting has limitations in terms of size and density of the nozzle array as well as the ejection frequency. Piezoelectric based devices suffer from poor pumping energy in addition to inadequate ejection frequency. Recently, an electrohydrodynamic (EHD) printing technique has been suggested and proposed as an alternative to thermal bubble or piezoelectric devices. In EHD jetting, a liquid (ink) is pumped through a nozzle and a strong electric field is applied between the nozzle and an extractor plate, which induce charges at the surfaces of the liquid meniscus. This electric field creates an electric stress that stretches the meniscus in the direction of the electric field. Once the electric field force is larger than the surface tension force, a liquid droplet is formed. An EHD inkjet head can produce droplets smaller than the size of the nozzle that produce them. Furthermore, the EHD nano-inkjet can eject high viscosity liquid through the nozzle forming tiny structures. These unique features distinguish EHD printing from conventional methods for sub-micron resolution printing. In this presentation, I will introduce the recent research results regarding the EHD nano-inkjet and the printing system, which has been applied to solar cell or thin film transistor applications.

Keywords: Electrohydrodynamic Nano-Inkjet Printing(전기수력학 프린팅), Printed Electronics(인쇄전자), Solar Cell(태양전지)