The fabrication and characterization of electrically addressable microfluidic electrowetting channels

Seyeoul Kwon, Jungwon Park and Philip D. Rack

Department of Materials Science and Engineering, University of Tennessee, Knoxville, TN 37996

Manjeet Dhindsa and Jason Heikenfeld,

Novel Devices Laboratory, Department of Electrical and Computer Engineering, University of Cincinnati, Cincinnati, Ohio 45220

Anatoli V. Melechko and Dale K. Hensley

Department of Material and Science and Engineering, North Carolina State University, Raleigh, NC, 27695

An electrowetting microfluidic platform designed for control and transport of aqueous ions and polar species has been fabricated on passive electrode as well as an active matrix thin film transistor arrays. Electrically addressable vertically aligned carbon nanofibers (VACNFs) were formed as nanoscale functional elements for the platform. The process integration issues of the passive and active devices and the fabrication procedures will be demonstrated. VACNFs with different spatial separation have been grown on electrode arrays via catalytic DC plasma-enhanced chemical vapor deposition to 15 um in height. Subsequently the VACNFs were electrically insulated with a conformal insulator such as organic Parylene C (εr~3, Ebd~2 MV/cm, γ~ 20 mN/m) via chemical vapor deposition, and hydrophobised with an insulating fluoropolymer coating. In this presentation, we will describe the processing issues involved in fabricating VACNF integrated devices and will introduce alternative vertical electrode schemes. Controlled liquid motion through the VACNFs will be demonstrated with reversible electrical wetting behaviors to form agile liquid channels within the VACNFs. The electrostatically induced fluidic activity can control the flow of polar/non polar species depending upon functionalization of the nanofiber arrays. Various schemes of electrofluidic testing of passive electrode arrays will be demonstrated. Finally, characteristics using amorphous silicon and advanced thin film transistor array with VACNFs will be demonstrated and a programmable lab on a chip platform will be discussed.

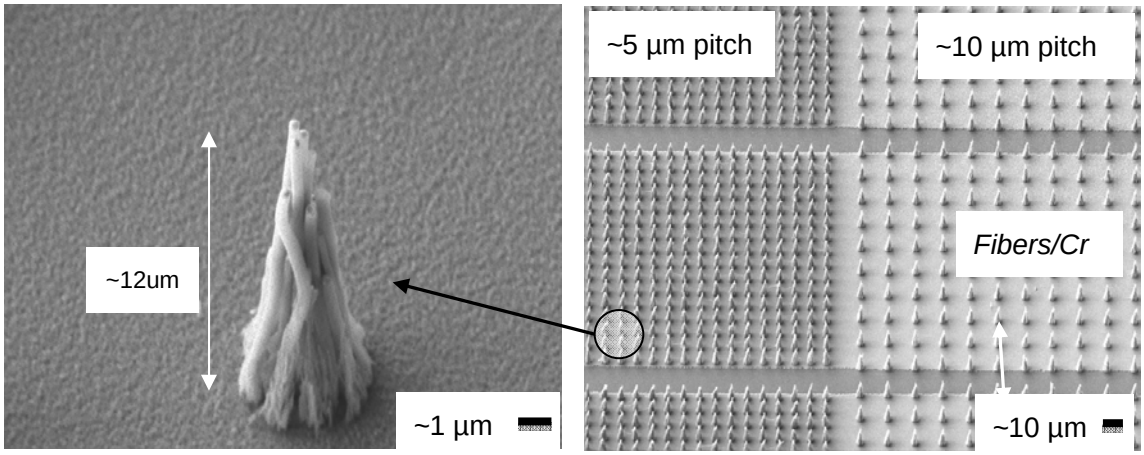

Fig.1: Electrically addressable vertically aligned carbon nanofibers on passive addressable array.

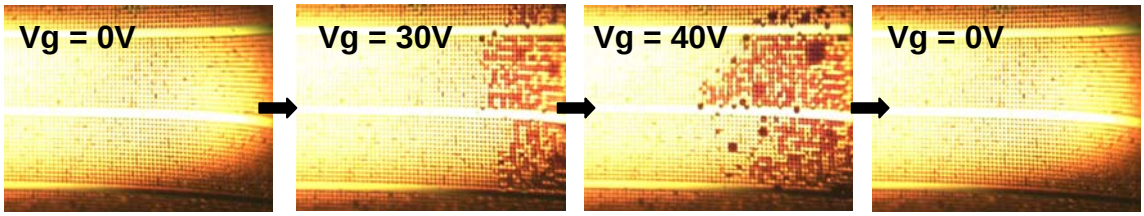

Fig.2 : *Electrowetting of carbon nanofibers to form agile liquid channels* : Reversible (water/dodecane) electrowetting was done to form agile liquid channel within carbon nanofibers.

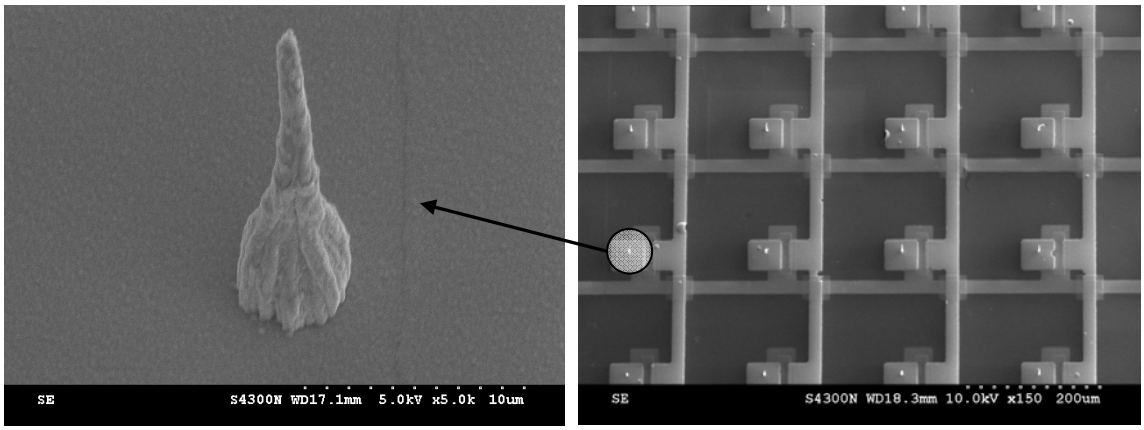

Fig 3: Electrically addressable vertically aligned carbon nanofibers on active matrix thin film transistors.