Research Seminar

NUS National University of Singapore

Department of Chemistry
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The Era of Atomic Crafting: Area Selective Atomic Layer Deposition

by Professor Han-Bo-Ram Lee
Incheon National University, South Korea

Host: A/P Chen Wei | Mon, 16 Sep 2019 14:00 – 15:00 S11-02-07, Physics Conference Room

About Professor Han-Bo-Ram Lee

Prof Lee obtained his doctoral degree from the Pohang University of Science and Technology in 2009 and did his postdoctoral at the Stanford University until 2013 before he returned to Korea and joined the Department of Materials Science and Engineering in Incheon National University as an Assistant Professor. He was promoted to Associate Professor in 2017. He has been an Associate Editor in Chemistry of Materials – ACS Publications since 2018 and an Editorial Board Member of Electronic Materials Letters since 2015. Prof Lee's current research interests and topics are focused on understanding surface chemical reactions and controlling properties, and applying this knowledge to various applications of which properties could be improved by functionalization of surface from nanoscopic to macroscopic ranges. Experimental controls and functionalization of surface properties are realized by dry and wet methods, including atomic layer deposition (ALD) and solution-based chemical reactions. Research applications are categorized into; 1) semiconductor device, 2) hydrophobic surface, 3)electronic textile, and 4) 2D materials.

Abstract

Area-selective atomic layer deposition (AS-ALD) is envisioned to play a key role in nextgeneration semiconductor processing and can also provide new opportunities in the field of electronic devices. Basics concept of AS-ALD is that an original surface is changed to activated and deactivated surfaces toward following ALD reactions, resulting in selective growth in one substrate. In most cases, deactivation of surface is a common way to control ALD growth, and special inhibitors for the surface deactivation have been proposed. In this presentation, various types of inhibitors reported will be reviewed and the next progress of AS-ALD for high volume manufacturing (HVM) will be discussed.

Self-assembled monolayer (SAMs) is the first proposed material as an inhibitor of AS-ALD. AS-ALD using SAMs has been extensively studied in various kinds of ALD materials and has shown some feasibilities to block growth of ALD. Polymer layers have been proposed as another approach. However, SAMs and polymers have several disadvantages in compatibility for HVM, such as long formation time, complex process sequence, and clean removal. Recently, our group has developed an AS-ALD using precursor type inhibitors and shown feasibilities of blocking properties in Ru and Pt ALD systems. In the following work, we investigated surface reactions during the adsorption of inhibitor and blocking processes using water contact angle measurement, density functional theory (DFT), and X-ray photoelectron spectroscopy (XPS). The results could provide insights in the next generation patterning process using ALD.

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