I. *"Semiconductor Material Systems for Advanced Device Applications "*

A continued need to improve performance of semiconductor devices in both electronic and photonic applications enforces continued aggressive search for innovative approaches to semiconductor materials and material systems engineering. The goal of this presentation is to introduce and discuss solutions to the emerging challenges accomplished through the introduction of highly engineered complex semiconductor material systems. Such materials systems have become technically viable because semiconductor technology has mastered an atomic level control of the material structure and composition. In this presentation advanced semiconductor material systems are discussed in both electronic and photonic applications with focus on the material and process aspects of semiconductor device technology.

As an introduction, a "top-down" and "bottom-up" approaches to semiconductor device manufacturing, results of the extreme material confinement, as well as atomic-scale deposition techniques of Molecular Beam Epitaxy (MBE) and Atomic Layer Deposition (ALD) are briefly discussed. Then, selected aspects of the MOSFET/CMOS gate stack and channel engineering, including "gate first" and "gate last" processes, channel geometry ("fins" and nanowires), high mobility channel materials, and heterogeneous integration on silicon are considered. Reminder of the presentation is devoted to an overview of the range of issues related to advanced semiconductor substrate engineering, organic semiconductors technology, carbon based material systems as well as issues related to large-area semiconductor electronics and photonics using both rigid and flexible substrates. The presentation is summarized by outlining potential future challenges as well as by identifying emerging major trends in advanced semiconductor device science and engineering.

** Lecture will be delivered in Polish using English-based illustrations.*

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