YNU 横浜国立大学 YOKOHAMA National University

物理工学談話会　6月23日（月）午後 15:30〜17:00
会場：総合研究棟W701　世話人：レービガー　ハンネス
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Flexible Electronics on Amorphous Oxide Semiconductor Devices: TFTs and RRAMs

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Amorphous oxide semiconductor (AOS) technology has emerged as a transformative platform for the development of advanced memory and logic devices, particularly in the field of flexible electronics. This talk will explore the evolution of AOS-based devices, from Thin-Film Transistors (TFTs) to Resistive switching RAMs (RRAMs), and their integration into a range of computing paradigms. AOS materials, such as Indium Gallium Zinc Oxide (IGZO), offer unique properties like high mobility, low temperature processing, and excellent flexibility, making them ideal for next-generation electronics. We will first examine the capabilities of IGZO TFTs, which have demonstrated remarkable performance in various display, sensor, and neuromorphic applications, highlighting their role as efficient access transistors in RRAMs crossbar arrays. Next, we will discuss the transition to RRAMs and how these devices exploit the resistive switching mechanism for non-volatile memory, enabling high-speed, low-power data storage. The advantages of RRAM technology, including its scalability, endurance, and energy efficiency, will be emphasized, particularly in the context of emerging neuromorphic computing systems such as Reservoir computing (RC). We also discuss the integration of AOS-based RRAMs into flexible and wearable electronics, highlighting their potential to revolutionize both conventional and unconventional computing paradigms. The goal of this talk is to provide insights into the progress of AOS-based RRAM technology and to inspire further exploration of its potential to reshape the future of computing, from memory-intensive applications to neuromorphic and AI-driven systems.

Low-cost non-volatile RF switches for millimeter wave applications

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Over the past three decades, wireless data rates have doubled every 18 months, requiring the adoption of advanced radio frequency (RF) bands for 5G and for the upcoming 6G communication systems. There is a special interest in the millimeter wave (mmWave) and THz spectrum for achieving seamless high-speed data transfers. However, deploying these technologies presents a unique challenge due to their shorter wavelengths, resulting in increased difficulty in signal penetration through objects, leading to reduced signal ranges. Innovative solutions like Reconfigurable Intelligent Surfaces (RIS) have emerged to overcome this limitation, offering the ability to extend, steer, and perform algorithmic computations mid-propagation on broadcast electromagnetic waves. One critical active RIS component is the RF switch, which plays an essential role in signal routing, impedance matching, and network reconfiguration. Traditional RF switches face limitations in terms of size, power consumption, and switching speed, hindering their performance in 6G applications. In this regard, the innovative non-volatile RF memristor stands out as a promising candidate due to the lack of static power consumption and the potential for extreme miniaturization. Recent advancements have shown that 2D devices exhibit remarkable properties, including RF switching capabilities up to 500 GHz, primarily benefiting from the ultra-thin 2D layers. Here we present an application-ready characterization of the first RF switches based on memristors fabricated through a combination of electrochemical exfoliation and liquid-liquid interfacial assembly. This novel 2D layer fabrication method yields uniform, low-defect bilayer MoS_2 nanosheet networks without relying on hazardous gases typical of chemical vapor deposition (CVD), offering a low-cost and environmentally friendly route towards CMOS-compatible integration.