NS-010 **<Invited Speaker>**

High Performance Flexible Inorganic Electronic Systems

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The demand for flexible electronic systems such as wearable computers, E-paper, and flexible displays has increased due to their advantages of excellent portability, conformal contact with curved surfaces, light weight, and human friendly interfaces over present rigid electronic systems. This seminar introduces three recent progresses that can extend the application of high performance flexible inorganic electronics. The first part of this seminar will introduce a RRAM with a one transistor-one memristor (1T-1M) arrays on flexible substrates. Flexible memory is an essential part of electronics for data processing, storage, and radio frequency (RF) communication and thus a key element to realize such flexible electronic systems. Although several emerging memory technologies, including resistive switching memory, have been proposed, the cell-to-cell interference issue has to be overcome for flexible and high performance nonvolatile memory applications. The cell-to-cell interference between neighbouring memory cells occurs due to leakage current paths through adjacent low resistance state cells and induces not only unnecessary power consumption but also a misreading problem, a fatal obstacle in memory operation. To fabricate a fully functional flexible memory and prevent these unwanted effects, we integrated high performance flexible single crystal silicon transistors with an amorphous titanium oxide (a-TiO2) based memristor to control the logic state of memory. The 8×8 NOR type 1T-1M RRAM demonstrated the first random access memory operation on flexible substrates by controlling each memory unit cell independently.

The second part of the seminar will discuss the flexible GaN LED on LCP substrates for implantable biosensor. Inorganic III-V light emitting diodes (LEDs) have superior characteristics, such as long-term stability, high efficiency, and strong brightness compared to conventional incandescent lamps and OLED. However, due to the brittle property of bulk inorganic semiconductor materials, III-V LED limits its applications in the field of high performance flexible electronics. This seminar introduces the first flexible and implantable GaN LED on plastic substrates that is transferred from bulk GaN on Si substrates. The superb properties of the flexible GaN thin film in terms of its wide band gap and high efficiency enable the dramatic extension of not only consumer electronic applications but also the biosensing scale. The flexible white LEDs are demonstrated for

the feasibility of using a white light source for future flexible BLU devices. Finally a water-resist and a biocompatible PTFE-coated flexible LED biosensor can detect PSA at a detection limit of 1 ng/mL. These results show that the nitride-based flexible LED can be used as the future flexible display technology and a type of implantable LED biosensor for a therapy tool.

The final part of this seminar will introduce a highly efficient and printable BaTiO3 thin film nanogenerator on plastic substrates. Energy harvesting technologies converting external biomechanical energy sources (such as heart beat, blood flow, muscle stretching and animal movements) into electrical energy is recently a highly demanding issue in the materials science community. Herein, we describe procedure suitable for generating and printing a lead-free microstructured BaTiO3 thin film nanogenerator on plastic substrates to overcome limitations appeared in conventional flexible ferroelectric devices. Flexible BaTiO3 thin film nanogenerator was fabricated and the piezoelectric properties and mechanically stability of ferroelectric devices were characterized. From the results, we demonstrate the highly efficient and stable performance of BaTiO3 thin film nanogenerator.

References

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