Invited Seminar

**HfO\(_x\) Based Resistive Memory Devices and Their Application to Sensorimotor Learning speed**

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**Abstract:**

Resistive switching phenomenon in transition metal oxide materials has been studied as a possible candidate technology for future non-volatile memory and neuromorphic applications. Here, we demonstrate an HfO\(_x\)-based resistive memory device with rare earth metal contact. The device resistance can be modulated with applied voltage and shows a repeatable and self-compliance binary switching with high yield and device-to-device uniformity. We made an array of such devices which is further used in a biologically-inspired architecture to demonstrate a simple sensorimotor learning task. Our algorithm imitates some features of the sensorimotor stage of cognitive development of a newborn baby. Motion and sensing are indicated by integrate and fire neurons, and the associations between neurons are learned in the resistive memory array using spike timing dependent plasticity as a local rule. This architecture at the high level performs a biased random walk algorithm using a fully connected spiking sensorimotor network. By simply redefining the input and output functions of the neurons we show that this system can be easily generalized to solve other optimization problems. This demonstrates a new approach to solve classical problems using biologically inspired components and novel memory technology that shows adaptive and fault-tolerant learning.

**Speaker Biography:**

Dr. Tayfun Gokmen is a research staff member at IBM T. J. Watson Research Center, Yorktown Heights, NY. He received two B.S. degrees from Middle East Technical University in Turkey in physics and electrical engineering (double major) in 2004. He completed his Ph.D. degree in electrical engineering from Princeton University in 2010 before joining Bloomberg L.P. as a software developer. In 2011, he joined IBM as a postdoctoral researcher where he involved in research and development work of Cu\(_2\)ZnSn(S,Se)\(_4\) based thin film solar cells. After appointed as a research staff member he started working on neuromorphic computing that leverages the physical properties of native devices such as resistive memory device. He has 5 pending/issued patents and published over 40 papers in various fields ranging from fundamental physics to device physics and engineering.