Seminar

Institute for Plasma Research

Title : Plasma fireball-mediated ion implantation for nonvolatile memory application

Speaker: Dr. Sudheer
Institute for Plasma Research, Gandhinagar

Date : 01st June 2022 (Wednesday)

Time : 03.30 PM

Venue : Online - Join the talk: https://lobby.ipr.res.in/Mukesh

Abstract :

Remarkable performance of nonvolatile memories based on resistive switching is expected to fulfill the requirements of next-generation data-intensive technologies [1,2]. However, due to the involvement of multi-processing steps and materials (separate growth of functional layer and electrodes) in the fabrication of the device, resistive random access memories (RRAM) still suffer from their implementation at a commercial scale. To resolve these problems, quick fabrication of resistive switching surfaces using a simple and cost-effective method is crucial for the development of the devices. We propose a technique in which depending upon the polarity, a single device is used to grow Ti thin film followed by plasma fireball-mediated oxygen ion implantation to transform the top surface of Ti film into a functional TiO_x layer to fabricate the RRAM device. The formation of the TiO_x layer at the near-surface region and oxygen-concentration gradient with depth in the implanted film is identified. The current-voltage characteristics of the device analyzed at the nanoscale show forming-free bipolar resistive switching, which is further confirmed by the two-fold erase-write process. At 5×10^{16} ions cm-2 fluence, resistive switching occurs at higher voltages, while at 5×10^{17} ions cm^{-2} fluence, it occurs at lower voltages. As an application, the rapid fabrication of periodic arrays of TiO_x-based squared memory cells of different sizes is demonstrated. The method can be utilized for the inexpensive production of high-density commercial devices on a large scale. The details of the work carried out and the future work will be discussed.

References:
1. M. Lanza et al., “Recommended Methods to Study Resistive Switching Devices,” Adv. Electron. Mater., vol. 1800143, pp. 1–28, (2018).
2. T. Shi et al. “A Review of Resistive Switching Devices: Performance Improvement, Characterization, and Applications,” Small Struct., vol. 2, no. 4, p. (2021).