

Characterizing the Chemical and Structural Effects of Processing on Nitrogen Doped Ge₂Sb₂Te₅

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There is intense interest in utilizing phase change materials (PCMs) in constructing non-volatile memory cells, fueled by recent advances in fabrication techniques and the promise of scalability beyond the limit of conventional DRAM and NAND flash memory. In order to reduce the RESET current – which determines the material properties, cell size, and electrode contact area – there has been a lot of focus on constructing highly scaled devices [1,2]. With aggressive scaling [3], it is important to understand the effects of etching as processing approaches the active area of the device. Furthermore, it is known that there is an etch-induced material modification layer resulting from reactive ion plasma etching [4]. We use a combination of depth profiled X-ray Photoelectron Spectroscopy (XPS) and X-ray Absorption Spectroscopy (XAS) to characterize this modified layer in nitrogen doped Ge₂Sb₂Te₅ (N:GST) thin films, etched in fluorine and chlorine based chemistries. The surface sensitivity of depth profile XPS showed the extent of the modification layer, as well as the selective removal and oxidation of elemental species (N,Ge,Sb,Te). XAFS is an ideal technique for providing local structure and bonding information (such as co-ordination number, bond distance, and mean square disorder) within the bulk of the modification layer. Using this technique, we characterize the drastic changes in local structure due to etching.

- [1] S Raoux et al, J. Appl. Phys., 102: 094305 (2007)
- [2] Y.C. Chen, C.T. Rettner, S. Raoux et al., IEDM Tech. Dig., p. S30P3, 2006.
- [3] S. Raoux, M. Salinga, J. L. Jordan-Sweet, A. J. Kellock, J. Appl. Phys. 101, 044909 (2007).
- [4] Courtesy of IBM Research (soon to be published) TEM data provided by Eric Joseph