원자힘현미경을 이용한 탄화규소 미세 패터닝의 Scanning Kelvin Probe Microscopy 분석

조영득, 방 욱, 김상철, 김남균, 구상모
광운대학교, 한국전기연구원*

Scanning Kelvin Probe Microscope analysis of Nano-scale Patterning formed by Atomic Force Microscopy in Silicon Carbide

Yeong-deuk Jo, Wook Bahng*, Sang-cheol Kim*, Nam-kyun Kim*, and Sang-mo Koo
Kwangwoon Univ., Korea Electrotechnology Research Institute (KERI)*

Abstract : Silicon carbide (SiC) is a wide-bandgap semiconductor that has materials properties necessary for the high-power, high-frequency, high-temperature, and radiation-hard condition applications, where silicon devices cannot perform. SiC is also the only compound semiconductor material, on which a silicon oxide layer can be thermally grown, and therefore may fabrication processes used in Si-based technology can be adapted to SiC. So far, atomic force microscopy (AFM) has been extensively used to study the surface charges, dielectric constants and electrical potential distribution as well as topography in silicon-based device structures, whereas it has rarely been applied to SiC-based structures. In this work, we investigated that the local oxide growth on SiC under various conditions and demonstrated that an increased (up to ~100 nN) tip loading force (LF) on highly-doped SiC can lead a direct oxide growth (up to few tens of nm) on 4H-SiC. In addition, the surface potential and topography distributions of nano-scale patterned structures on SiC were measured at a nanometer-scale resolution using a scanning kelvin probe force microscopy (SKPM) with a non-contact mode AFM. The measured results were calibrated using a Pt-coated tip. It is assumed that the atomically resolved surface potential difference does not originate from the intrinsic work function of the materials but reflects the local electron density on the surface. It was found that the work function of the nano-scale patterned on SiC was higher than that of original SiC surface. The results confirm the concept of the work function and the barrier heights of oxide structures / SiC structures.

Key Words : SiC, SKPM, nano-scale patterning, surface characteristics

Acknowledgement

This work was supported by "system IC2010" and "Survey of high efficiency power devices and inverter system for power grid" projects of Korea Ministry of Knowledge Economy.