Poster Session | F. From Microstructure to Properties: Mechanisms, Microstructure, Manufacturing

[PO-F2]Poster Session 2

Symposium F

Wed. Oct 31, 2018 5:45 PM - 8:00 PM Poster Hall

[P2-48]Stress analysis of 4H-SiC power devices via FEM and Raman spectroscopy

○Hiroki Sakakima[1], Asuka Hatano[1], Akihiro Goryu[2], Kenji Hirohata[2], Satoshi Izumi[1] (1.The Univ. of Tokyo, Japan, 2.Toshiba, Japan)

We developed a scheme to analyze the stress distribution of 4H-SiC power devices by FEM and Raman spectroscopy. Raman spectroscopy is widely applied as a method for evaluating stress distribution of semiconductor devices. However, the relationship between phonon frequency, which is measured by Raman spectroscopy, and stress tensor is not clarified for 4H-SiC. In addition, it is impossible to evaluate the distribution of the stress tensor having six components only by Raman spectroscopy since the phonon frequency is a scalar quantity. To solve these problems, we detected phonon deformation potentials, which are the relationships between phonon frequency and stress tensor, and developed the analysis method combining FEM and Raman spectroscopy. Firstly, phonon deformation potentials were detected by first principle calculation. The phonon frequency of the strained crystal is calculated. All components of the phonon deformation potential constants were obtained from the relationship between the magnitude of stress and the phonon frequency shift. The calculated deformation potential constants were validated by previous experimental results. Secondly, multi-step thermal-stress FEM analysis which reproduces actual fabrication process was conducted for a pin diode. Young's modulus, linear expansion coefficient and intrinsic stress of thin films formed on SiC substrates were measured. The obtained stress distribution was converted into the distribution of the phonon frequency shift and validated through comparison with the result of the micro Raman spectroscopy. The obtained stress distribution and its origin will be presented. This work was supported by Council for Science, Technology and Innovation(CSTI), Cross-ministerial Strategic Innovation Promotion Program (SIP), “Next-generation power electronics/Consistent R&D of next-generation SiC power electronics” (funding agency: NEDO)