

Fabrication of High-quality SiC-MOSFETs for Advanced Power Electronics

Heiji WATANABE

(Osaka University, Department of Materials and Life Science, Professor)

【Outline of survey】

Silicon carbide (SiC) is a promising candidate materials for high-power, high-frequency, and high-temperature electronic devices. SiC has superior physical and electrical properties compared to silicon (Si) for power device application.

However, the poor characteristics of the thermally grown oxides on SiC substrates limit the device performance of possible metal-oxide-semiconductor field-effect transistors (MOSFETs). The purpose of this research is to realize high-performance SiC-MOSFETs by utilizing (a) atmospheric pressure plasma surface cleaning, (b) high-quality ultrathin SiO₂ underlayers and plasma treatment method, and (c) Al-based high-permittivity (high-k) gate dielectrics (high-k/SiO₂/SiC stacked structures).

【Expected results】

A change of technology from silicon to silicon carbide will revolutionize the power electronics, and play an important role in the energy and transport technologies of the 21st century. In addition, preparation of ideal SiC surfaces and high-quality insulator/SiC interfaces have gained considerable attention, from the viewpoint of material science.

【References】

- Investigation of 4H-SiC MIS devices with AlON/SiO₂ layered structures, M. Harada, Y. Watanabe, S. Okada, T. Shimura, K. Yasutake, and H. Watanabe, Materials Research Society 2007 Spring Meeting.
- Surface cleaning and etching of 4H-SiC(0001) using atmospheric pressure hydrogen plasma, H. Watanabe, S. Okada, H. Ohmi, H. Kakiuchi, and K. Yasutake, Materials Research Society 2006 Spring Meeting.
- High-quality HfSixOy gate dielectrics fabricated by solid phase interface reaction between physical-vapor-deposited metal-Hf and SiO₂ underlayer, H. Watanabe, M. Saitoh, N. Ikarashi, and T. Tatsumi, Appl. Phys. Lett. 85, 449-451 (2004).

【 Term of project 】 FY2007 - 2011

【 Budget allocation 】 15,700,000 yen
(2007 direct cost)

【Homepage address】

<http://www-asf.mls.eng.osaka-u.ac.jp/>