수소처리를 통한 탄화규소 쇼트키 다이오드의 역방향 특성 개선
Improvements in the reverse characteristics of 4H-SiC Schottky barrier diodes by hydrogen treatments

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1. Introduction

Superior material properties make silicon carbide (SiC) a very promising candidate for high-power and high-frequency devices. For power device applications, SiC's large bandgap translates into a high critical field. However, due to the difficulty in the formation of well-controlled metal/SiC interface, the reverse leakage current of Schottky barrier diodes can be significantly increased prior to junction breakdown. An increase in reverse leakage current of SBDs leads to higher power loss and premature breakdown. It is therefore important to reduce reverse leakage current.

Hydrogen is extensively used in semiconductor processing to influence the electrical activity of defects and impurities both at the surface and in the bulk of semiconductor. On account of its small size and strong covalent bonds it forms with Si and C, it ties up all dangling bonds without the necessity of the surface reconstruction, thereby providing an efficient chemical and electronic passivation of the surface.

2. Experimental

After Schottky contact metallization hydrogen treatment was performed in two ways : hydrogen annealing and hydrogen plasma. Hydrogen annealing was conducted in 42 Torr with a 99%H2 flow of 50 sccm at 300 ℃ and for 5 min with rapid thermal annealing system. On the other hand, hydrogen plasma treatment was performed under the condition of 50 W RF power, 200 mTorr pressure with a hydrogen flow of 50 sccm, and 1 hour in RIE system. The effects of hydrogen treatment on the electrical characteristics of 4H-SiC schottky barrier diodes were investigated using I-V (HP4155) and C-V (HP4280, 1MHz) measurement techniques.

3. Results

We fabricated 4H-SiC Schottky barrier diodes with various metals such as titanium, nickel and platinum. Density of interface states and surface energy level were calculated 1.8×10^{12} $cm^{-2}eV^{-1}$ and 1.76 eV, respectively. In order to reduce reverse leakage current, hydrogen annealing and hydrogen plasma treatment were performed. An improvement of reverse leakage current was observed by annealing in H_2 ambient at 300 ℃ for 5 min.