STANDARD EDITING SAMPLE

Journal Article

Abrasive-free chemical planarization of 4H-SiC substrate using ~~a~~ catalytic platinum and hydrofluoric acid

1. Introduction

Silicon carbide (SiC) is a wide-band-gap semiconductor and has excellent electric properties. ~~Especially~~In particular, 4H-SiC has a high breakdown field and ~~a~~ high thermal conductivity~~. Thus, 4H-SiC is~~, making it a promising candidate for high-~~power~~ and low-power-consumption device ~~substrate. The flat~~substrates. Flat and well-ordered 4H-SiC surfaces are ~~requested~~in demand for electric devices~~, because~~ due to the degradation of their process yield and device ~~property become worse.~~properties. However, it is difficult to meet this demand using the ~~demand by~~ conventional planarization process because of ~~its~~the mechanical hardness and chemical inertness~~.~~ of the surfaces. To ~~answer~~meet the ~~request~~growing demands, we developed a novel planarization process~~. We call this process~~ called catalyst-referred etching (CARE) [1-3]. CARE is a chemical etching process that ~~occurs~~is only carried out near ~~on~~ the catalyst plate. We use platinum plate as ~~a~~the catalyst plate and hydrofluoric acid. In our previous study, we planarized 2-inch 4H-SiC substrates. ~~The large~~Large diameter substrates are ~~demanded~~in demand for efficient volume production [4]. ~~We~~Therefore, we need to ~~confirm that the~~investigate whether large~~–~~-diameter substrates can be planarized by CARE. In this study, we developed a CARE system for 3-inch SiC substrates and evaluated the processed 3-inch 4H-SiC substrate surface.

2. Experimental procedures

A commercially available 3-inch n-type 4H-SiC (0001) 3.5° off-axis (toward <11$\bar{2}$0>) substrate was used. The substrate placed onto ~~the~~a platinum plate. The substrate and the plate were immersed in 50% hydrofluoric acid, and ~~rotated~~the parallel axes~~.~~ were rotated. The ~~process~~processing time was 3 ~~hours~~h. The surface was observed by phase-shift interference microscopy and atomic force microscopy~~.~~ (AFM).

3. Results

Figure 1 shows the preprocessed surfaces measured by phase-shift interference microscopy. The preprocessed surface ~~has~~had a lot of scratches. We planarized the substrate ~~by~~using CARE. The removal rate was ~~77nm~~77 nm/h. ~~Fig.~~Figures 2 and 3 show the phase-shift interference microscopy image and AFM image of the CARE processed surface. The scratches were removed ~~by~~using CARE, and the processed surface ~~is~~was found to be extremely flat. ~~We observed the~~ The processed surface was observed all over the substrate by phase-shift interference microscopy (64~~×~~ × 48 ~~μm~~μm^2 area). The root-mean square (RMS) roughness of the surfaces ~~is~~was less than 0.1 nm at all points. We ~~find~~found that ~~all around~~the 3-inch 4H-SiC substrates ~~are~~were planarized all around by CARE ~~just like~~in the same manner as the 2-inch 4H-SiC substrates. ~~We consider~~Therefore, we conclude that CARE ~~process~~ can also be used to planarize ~~larger diameter~~ substrates with larger diameters, such as 4-inch substrates ~~from these experimental results~~.

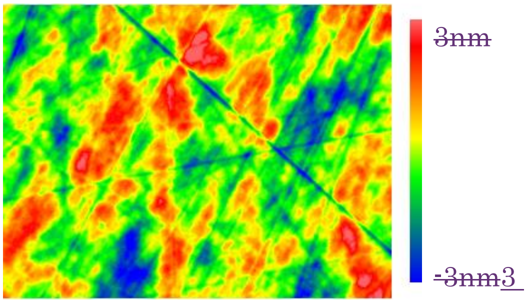

Figure 1. Phase-shift interference microscopy image of the pre-processed surface (64 × 48 μm^2 area); P-V: 7.406 nm, rms: 1.126 nm

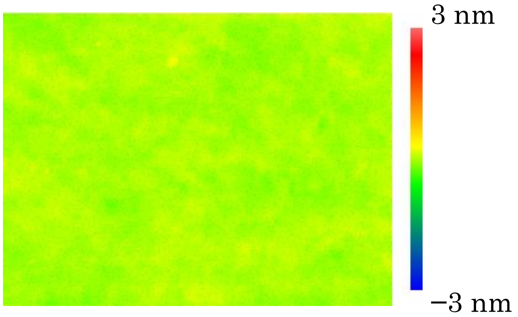

Figure 2~~ phase~~. Phase-shift interference microscopy image of the CARE processed surface (64 × 48 μm^2 area); P-V: 0.643 nm, rms: 0.072 nm

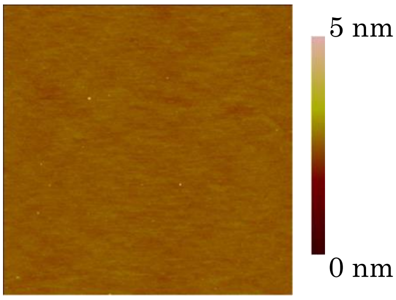

Figure 3. AFM image of the CARE processed surface (10 × 10 μm^2 area); P-V: 6.169 nm, rms: 0.089 nm

4. ~~Acknowledgement~~Acknowledgements

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