

Supporting Information

for

Using Visible Laser–Based Raman Spectroscopy to Identify the Surface Polarity of Silicon Carbide

Submitted by

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Measurements of more positions on SiC wafers

To clearly prove that we can identify the surface polarity of SiC by visible light based Raman spectroscopy, we also measured the Raman signals from many positions on different 4H-SiC wafers. Figure S1 displays the photographs of the 4H-SiC wafers, named sample A to sample C. The grid points, numbers, and letters represent the measured positions. Figure S2 presents the Raman peak intensity ratios of the signals at 210 and 203 cm^{-1} obtained from the C and Si faces at the each position of the three 4H-SiC wafers. Obviously, we found that the peak intensity ratio of the signals at 210 and 203 cm^{-1} was always higher when measured on Si face than on the C face, for all positions on the three different SiC wafers. Therefore, the result provides clear and convincing evidence that we can identify the surface polarity of SiC by using visible laser-based Raman spectroscopy.

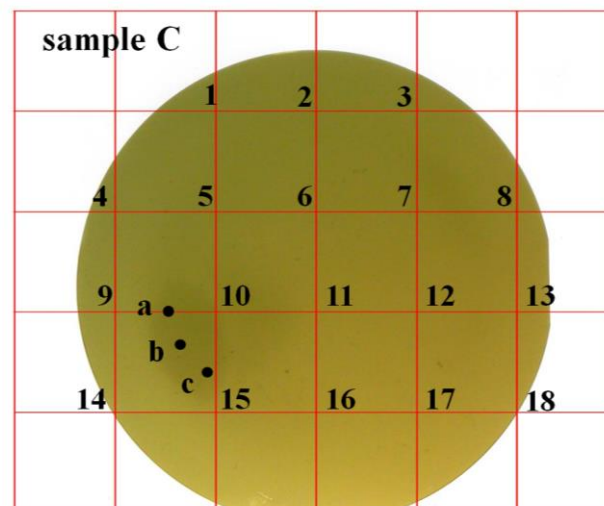
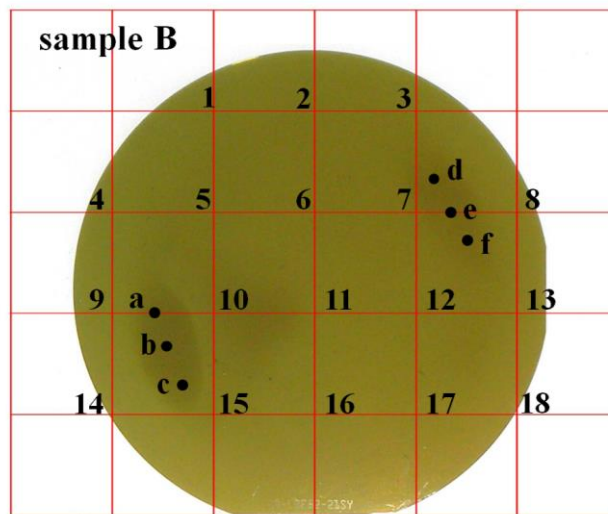
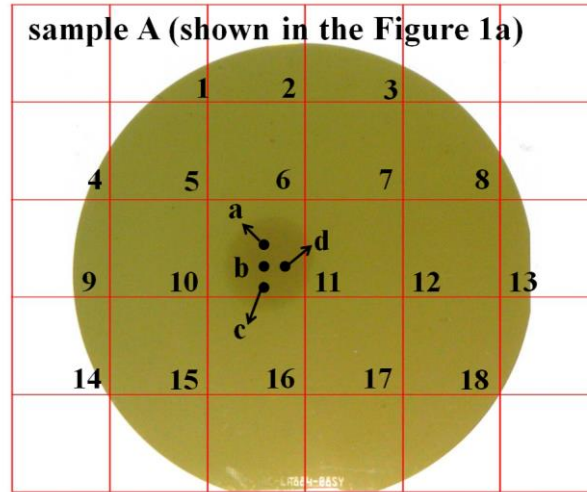


Figure S1. Photographs of the 4H-SiC wafers measured in this study.

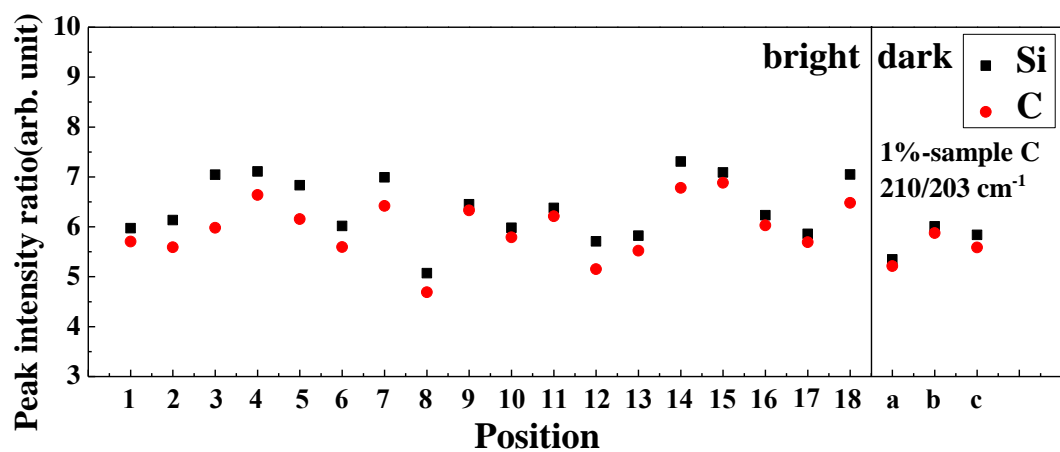
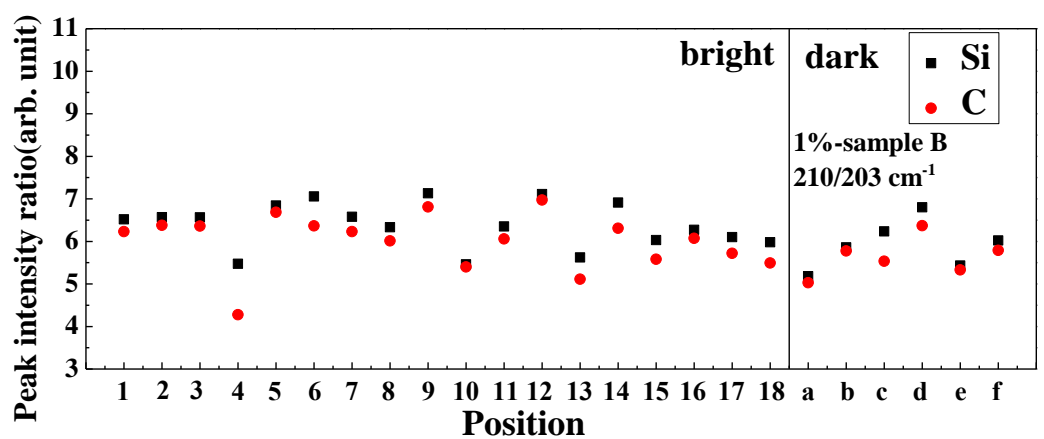
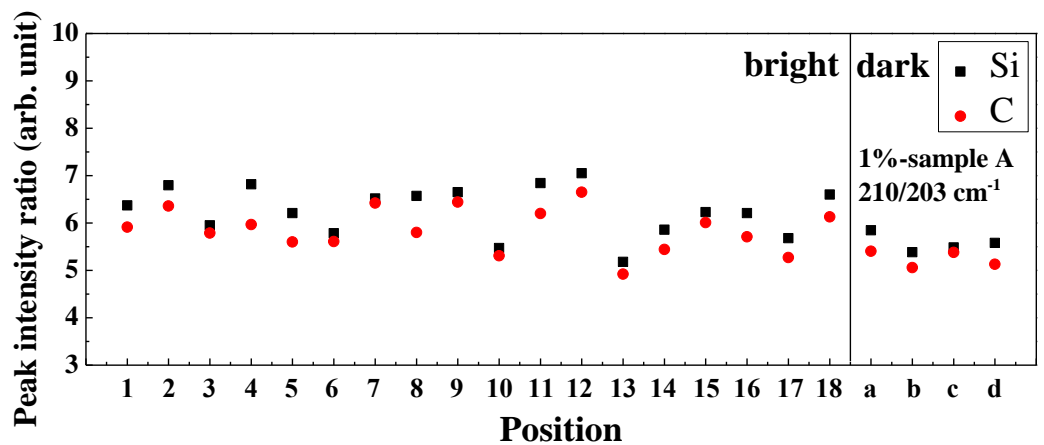


Figure S2. The Raman intensity ratios of the signals at 210 and 203 cm^{-1} on the Si

The determination of the intensity of the two FTA doublet modes

As shown in Figure 5a and 5c, the Raman spectra of two FTA doublet modes do not display flat backgrounds. Therefore we took a simple baseline removal method (Figure S3) to determine the intensity of the two FTA doublet modes. Similar approach to determine the intensities of peaks was used in previous literature.^{S1}

1. Take the Raman spectra in Figure 5c as an example, we first linearly fitted the Raman spectra of the background signals at both sides of the two FTA doublet modes, as the blue lines shown in Figure S3.
2. Then, we connected two close endpoints of blue lines to estimate a baseline, as the green line shown in Figure S3.
3. After the above operation, we can calculate the Raman intensities of the peaks at 203 and 210 cm^{-1} by subtracting an estimated baseline, as shown in Figure S3.

REFERENCES

- (S1) Jiang, J. L.; Wang, Q.; Huang, H.; Zhang, X.; Wang, Y. B.; Geng, Q. F. Microstructure Evolution Induced by Ultraviolet Light Irradiation in Ti-Si Codoped Diamond-like Carbon films. *J. Inorg. Mater.* **2014**, *29*, 941-946.

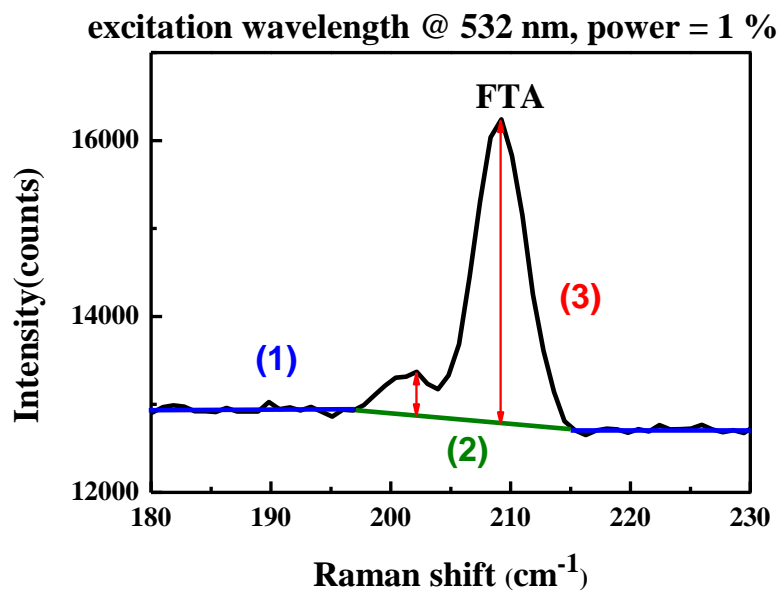


Figure S3. The baseline removal method we adopted in this study to determine the intensities of the two FTA doublet modes.

Identification of the surface polarity of SiC by using a Raman system having a 473 nm excitation laser

To confirm the idea of using visible laser to identify the surface polarity of SiC, we further employed another micro Raman system using a 473 nm excitation laser to confirm the measured results. Micro-Raman spectra of the SiC wafer were measured using a commercial micro-Raman microscope (UniRAM, UniNanoTech) equipped with a monochromator having a focal length of 30 cm. The wavelength of the excitation laser line was fixed at 473 nm. The laser beam was focused by a 50× objective having a numerical aperture of 0.55. The power of the excitation laser was fixed at 100 mW. The spot size of the excitation laser was approximately $0.86 \mu\text{m}^2$; the integration time was 75 s.

Figure S4 displays a photograph of the micro-Raman system having a 473 nm excitation laser. Figure S5 displays a Raman spectrum of 4H-SiC (sample A, position 1, Si face) obtained from an excitation laser having a wavelength of 473 nm with an attenuated intensity of 1%. The Raman spectrum also appeared two optical phonon peaks at 203 and 778 cm^{-1} , corresponding to the FTA and FTO vibration modes of 4H-SiC, respectively. Figure S6 displays the FTA mode of a 4H-SiC wafer excited by a 473-nm laser with an attenuated intensity of 1%. Notably, the signal of the FTA mode still appeared of a doublet, with a sharp peak at 203 cm^{-1} and a weaker peak at

194 cm^{-1} . To identify the surface polarity of SiC, we measured the Raman spectra of 18 positions in bright region and 4 positions in dark region, as displayed in the photograph of the 4H-SiC (sample A) in Figure S1. We observed and calculated the peak intensity ratios between the signals at 203 and 194 cm^{-1} at various positions, as displayed in Figure S7. We noted that the peak intensity ratios of the signals at 203 and 194 cm^{-1} were always higher when measured on Si face than on the C face, for all 22 positions (1–18 in bright region, a–d in dark region). This feature is the same as the experimental result that we demonstrated by using an excitation laser having a wavelength of 532 nm.

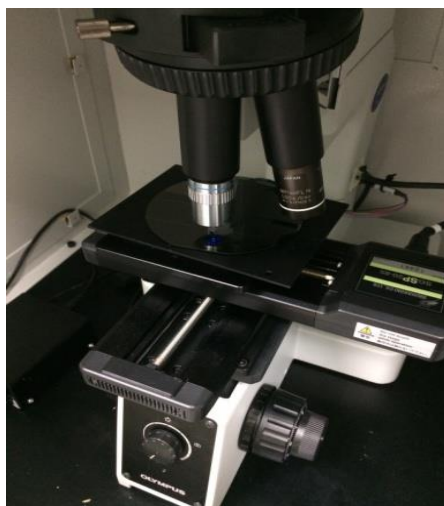


Figure S4. The photograph of the micro-Raman system having a 473 nm excitation laser used to characterize the SiC wafers.

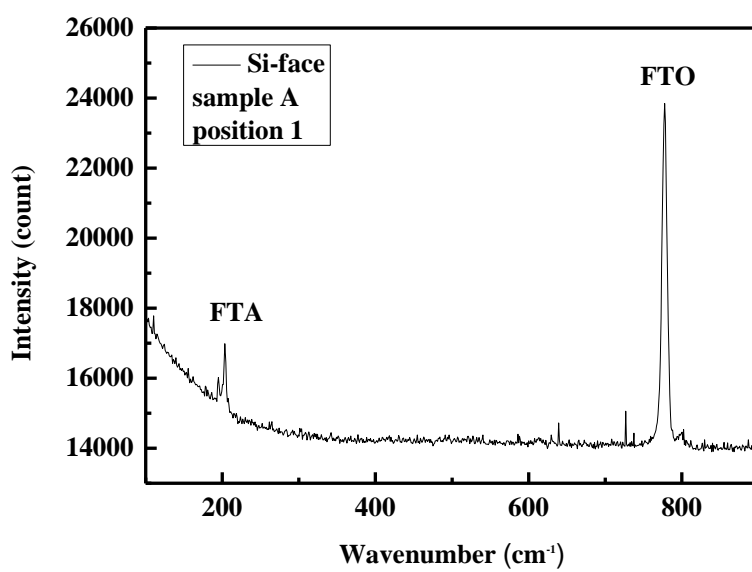


Figure S5. The Raman spectrum of 4H-SiC (sample A, position 1, Si face).

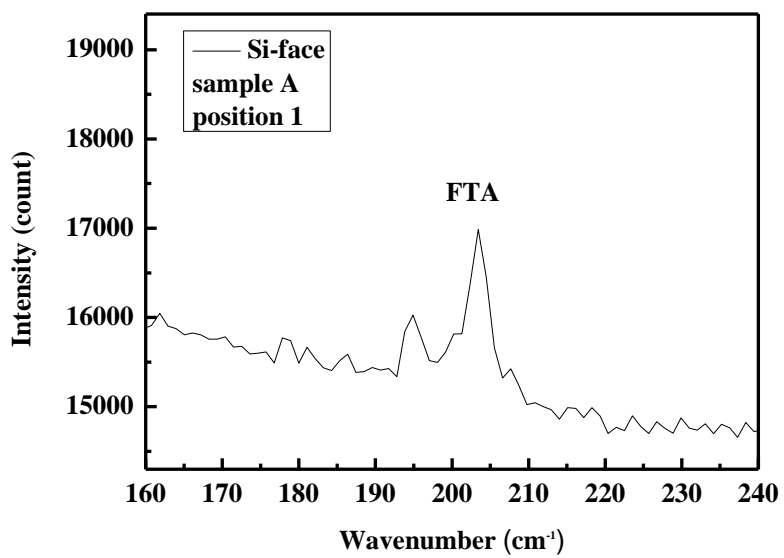


Figure S6. The FTA mode of a 4H-SiC wafer excited by a 473-nm laser.

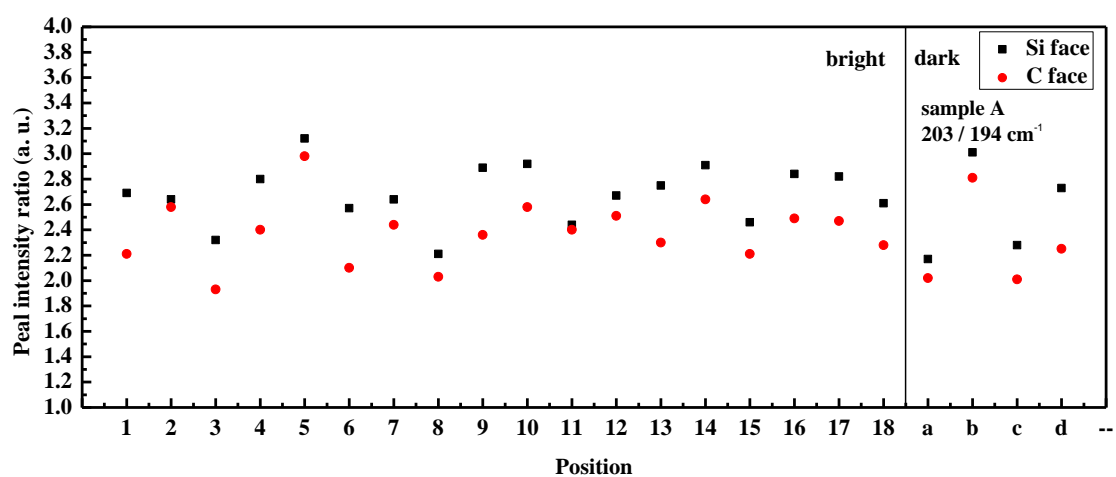


Figure S7. The Raman peak intensity ratios of the signals at 203 and 194 cm^{-1} obtained from the C and Si faces at the each position of the 4H-SiC wafer (sample A).