

Polymer assisted sublimation graphene growth on 4° off SiC(0001)

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Homogeneous graphene can be grown using a polymer as a carbon source, when the polymer is pre-coated onto a SiC(0001) substrate and then heated. This technique is called polymer-assisted sublimation growth (PASG) and enables graphene growth with suppressed step bunching [1,2]. While 4° off SiC substrates are commonly used in SiC-based power devices, there are no reports of graphene growth on off-axis SiC substrates using the PASG method. In this study, we investigated the effects of off-angle and polymer concentration on graphene growth using the PASG method.

Polymer solutions were spin-coated onto 4H-SiC(0001) substrates with off-angles of 0.0, 0.2, 0.5, 1.0, 2.0, and 4.0° along the [1-100] direction. We used photoresist polymer AZ-5214E dissolved in isopropanol solvent at concentrations of 2000, 3000, 4000, 5000, 6000, 7000, 8000, and 10000 ppm. Graphene samples were grown by heating these substrates in an Ar atmosphere at the temperature optimized for each off-angle.

Figure 1 shows atomic force microscope (AFM) images of samples at different polymer concentrations on a 4.0° off-axis SiC substrate. Compared to 0 ppm, step bunching was effectively suppressed at 5000 ppm. However, at 10000 ppm, numerous substances adhere to the surface, suggesting the presence of excess polymer. Figure 2 shows the averaged step height on the substrate surface at various off-angles and polymer concentrations. It was found that the averaged step height decreased with increasing polymer concentration in all off-angle samples. It was also found that the polymer concentration required to suppress step bunching increased with increasing off-angle. This suggests a correlation between the density of steps where graphene nucleation occurs and the amount of polymer required as a carbon source.

References:

- [1] M. Kruskopf, et al., 2D Mater. 3, 041002 (2016).
- [2] D. M. Pakdehi, et al., ACS Appl. Mater. Interfaces 10, 6039-6045 (2018).

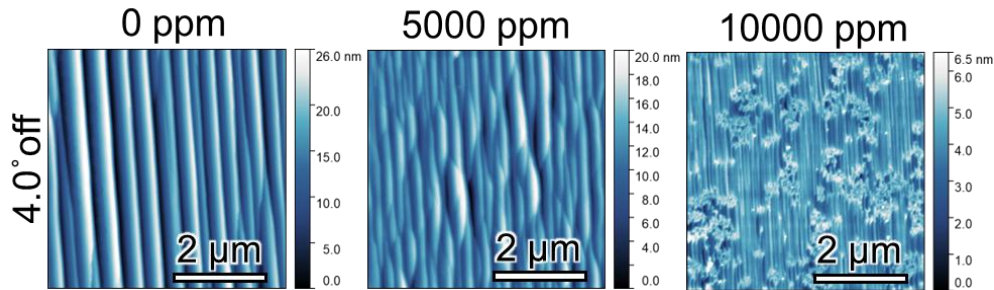


Fig. 1: AFM topography images of the graphene/SiC samples with different polymer concentrations.

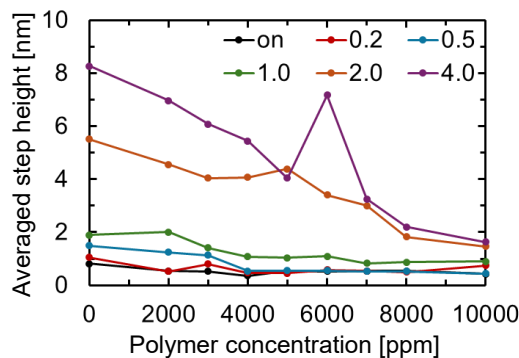


Fig. 2: Averaged step height with different off-axes and polymer concentrations.