

Supplemental Information

Step-templated CVD growth of aligned graphene nanoribbons supported by single-layer graphene film

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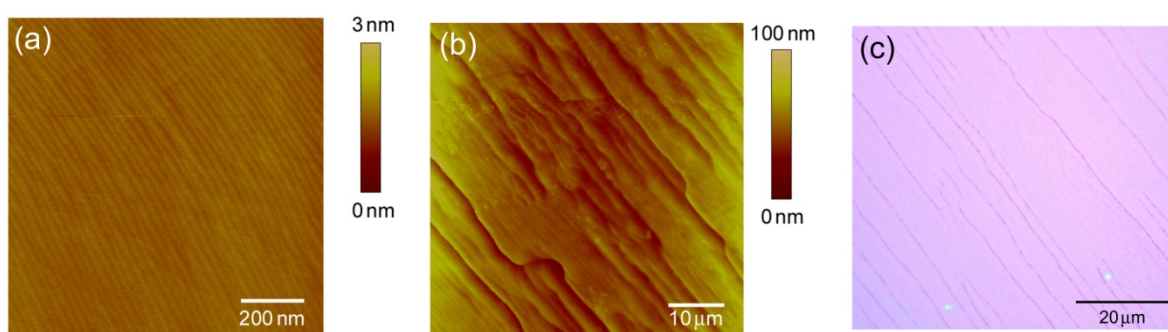


Figure S1. (a) AFM image of the sapphire surface with low miscut angle (0.8°). The sapphire was annealed in air at 900 °C before the measurement. (b) AFM image of Co surface measured after CVD. (c) Optical micrograph of transferred graphene film on a SiO₂/Si substrate.

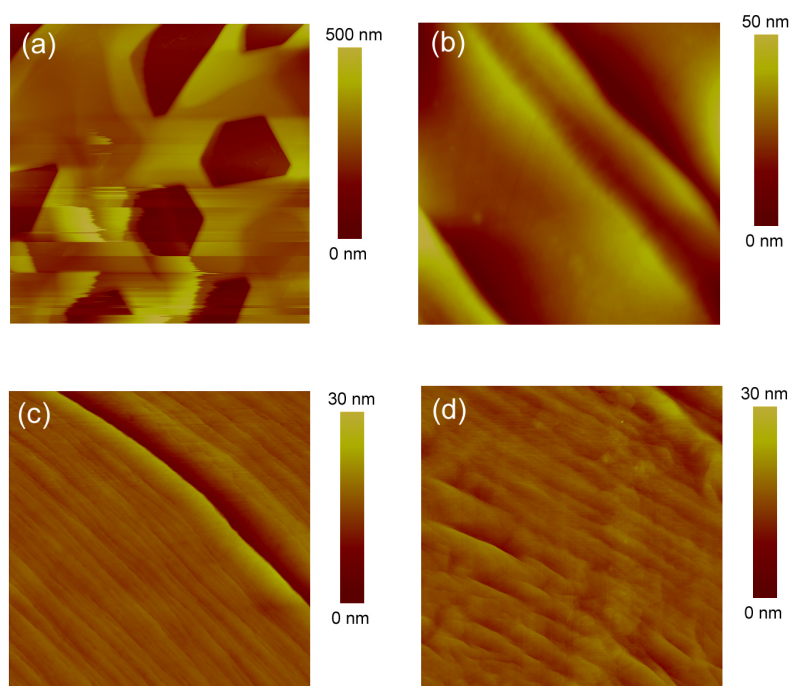


Figure S2. AFM images of the surface of Co film after CVD with different pre-annealing conditions (the sapphire with miscut angle 2.0° was used as a substrate). The graphene growth was carried out by flowing $\text{CH}_4/\text{H}_2/\text{Ar}$ mixed gas at 1000°C for 20 min. (a) No H_2 pre-treatment prior to the graphene growth at 1000°C . (b) H_2 pre-annealing at 500°C . (c,d) H_2 pre-annealing at 500°C , followed by the second annealing at 1000°C for 10 min (c) or 20 min (d). These images show the importance of H_2 pre-annealing processes at 500 and 1000°C to induce the clear step/terrace structure on the Co surface. The longer annealing time at 1000°C slightly deteriorates the step structure (d).

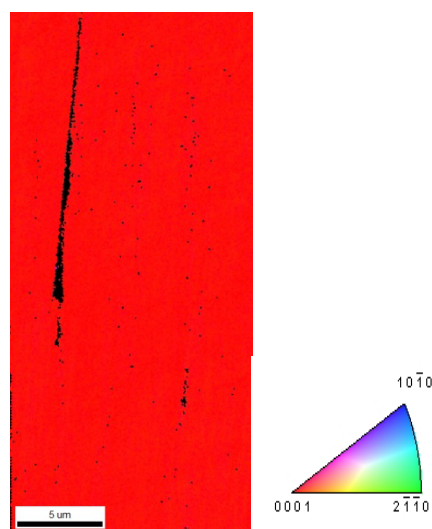


Figure S3. Crystallographic orientation of the Co film formed on miscut sapphire by electron backscatter diffraction (EBSD). The red contrast shows that the Co has (0001) plane normal to the substrate surface.

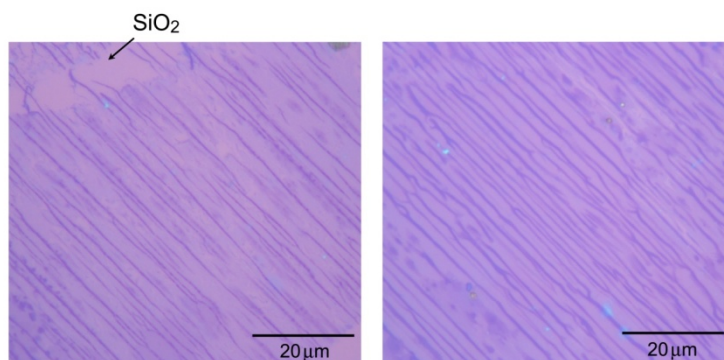


Figure S4. Optical microscope images of the transferred graphene film which was grown on the Co/sapphire (miscut angle is 2.0°). In the CVD, the cooling process was carried out in Ar/H₂ gas (96:4). The samples shown in Fig. 3 were cooled in pure H₂ flow, giving more uniform graphene sheet.

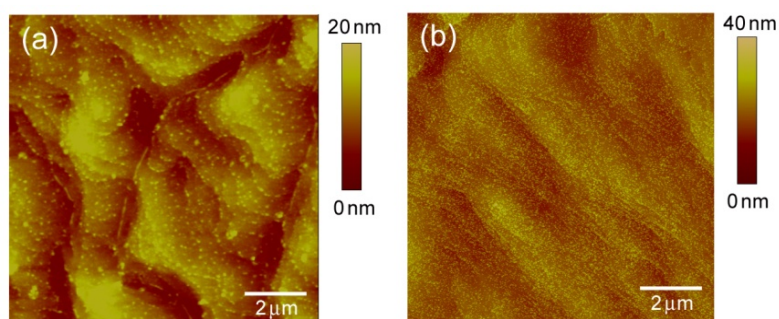


Figure S5. AFM image of the surface of Cu/sapphire substrate after CVD. The CVD temperature is 1000 °C (a) and 900 °C (b), and the sapphire with miscut angle of 2.0° is used.