Experimental Details

The Fe-Co/MgO catalyst system with a stoichiometric composition of 2.5:2.5:95 wt.%, was prepared by the impregnation method. First, the weighted amount of metal salts, Fe(NO₃)₃·9H₂O and Co(NO₃)₂·6H₂O, were dissolved separately in ethanol with agitation. Next, MgO with a surface area of 130 m²/g was completely dispersed into 30 ml of ethanol and the metal salt mixtures were added to this MgO solution. The final
mixture was sonicated for approximately 1 hour. Next, the ethanol was evaporated under continuous agitation, and the catalyst system was further dried overnight at 60 °C. Finally, the catalyst was calcinated in air at 500 °C for 2 hours.

Few-layer graphene sheets were grown by Radio Frequency (RF) catalytic Chemical Vapor Deposition (cCVD) on the MgO supported Fe-Co bi-metallic catalyst system utilizing acetylene as a hydrocarbon source. Approximately 100 mg of the catalyst was uniformly spread into a thin layer on a graphite susceptor and placed in the center of a quartz tube with inner diameter of 1 inch. First, the tube was purged with the carrier gas (Argon) for 10 minutes at 150 ml/min. Next, the RF generator (which provides a very fast heating rate of 300-350 °C/min) was turned on to begin heating. When the temperature of the graphite boat reached 1000 °C, acetylene was introduced at 4.5 ml/min for 30 minutes. At the end of the reaction, the system cooled down under the presence of Argon for 10 minutes. The as-produced graphene sheets were purified in one easy step using diluted hydrochloric acid solution and sonication.

Characterization Techniques

Transmission Electron Microscopy (TEM) images were collected on a field emission JEM-2100F TEM (JEOL Inc.) equipped with a CCD camera. The acceleration voltage was 100 kV for the graphene analysis. The graphene nanosheets were homogeneously dispersed in 2-propanol under ultra-sonication for 30 minutes. Next, a few drops of the suspension were deposited on the TEM grid, dried, and evacuated before analysis.
The STM in this study was a homebuilt beetle-style STM with RHK technology SPM1000 controller and XMP software with Axon CV4 current amplifier. STM imaging was performed in dry N₂ at room temperature. A drop of graphene solution (flakes of graphene dispersed in iso-propanol) was deposited on the Au/mica substrate, which was then allowed to dry in air.

Atomic Force Microscopy (AFM) measurements were performed using a Veeco Dimension 3100 instrument. This instrument has a scan range of 90 μm for the “x/y” direction and 6 μm for the “z” direction, respectively. After the graphene sheets were individually dispersed into 2-propanol solution, a few drops of the final solution were pipetted on Si substrates. Next, the substrates were air dried and placed directly under the AFM tip for morphology analysis.

Brunauer-Emmett-Teller (BET) and Langmuir surface area analyses were determined by recording nitrogen adsorption/desorption isotherms at 77 K using a static volumetric technique with a Micromeritics ASAP 2020 instrument. Before the physisorption measurements, the graphene sample was degassed at 623 K for 4 h under vacuum.

Raman scattering spectra were recorded at room temperature using Horiba Jobin Yvon LabRam HR800 equipped with a CCD. A spectrometer with a grating of 600 lines/mm and a He-Ne laser (633 nm) was used as an excitation source. The laser beam intensity measured at the sample was kept at 5 mW and Raman shifts were calibrated with a silicon wafer at a peak of 521 cm⁻¹.

The X-ray powder diffraction profiles of the graphene sheets were recorded in the 0-2θ mode on the Bruker D8 Discovery diffraction system (Bruker AXS).
Corporation). The monochromatic Cu Kα radiation line and general area detector diffraction system were used as an excitation source and detector, respectively. The experiments were carried out in Bragg-Brentano geometry. Quantitative analysis was performed with whole pattern fitting and Rietveld refinement.

**Atomic Force Microscopy**

![3-D representation of a 1 µm × 1 µm AFM scan of graphene sheets overlaid on the Si surface.](image)

Figure S1. 3-D representation of a 1 µm × 1 µm AFM scan of graphene sheets overlaid on the Si surface.

**X-ray Diffraction Analysis**

The number of graphene layers was calculated by using the value of the d-spacing and the size of the crystallite. Bragg’s law was used to estimate the value of the d-spacing as shown by the following formula:

\[ n\lambda = 2d \cdot \sin \theta \]

where \( \lambda \) is the wavelength of incident x-rays (in this case 1.54 Å) and \( \theta \) is the scattering angle of the C(002) peak.
The crystallite size was estimated from the diffraction peak widths using the Scherrer equation:

\[ \beta_{hkl} = \frac{K \lambda}{L_{hkl} \cos \theta_{hkl}} \]

where \( \beta \) is the width of the peak at half maximum intensity of a specific phase \((hkl)\) in radians, \( K \) is a constant and in this case is taken equal to 0.9, \( \lambda \) is the wavelength of incident x-rays, \( \theta \) is the center angle of the peak and \( L \) is the crystallite length.