# Insights into Inductively Coupled Plasma Chemical Vapor Deposition and Water Functionalization of Vertical Graphene Nanowalls

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Vertical graphene nanowalls (VGNWs) have emerged as promising supports for electrochemically active materials owing to their intrinsic physicochemical properties[1], including high electrochemical surface area, electrical conductivity and chemical stability. Precise synthesis and functionalization control will unlock their use in future energy harvesting systems. Here, we report a systematic investigation on the $C_2H_2/H_2/Ar$ gas mixture variation during inductively coupled plasma chemical vapor deposition (ICP-CVD)[2]. Subsequently, water plasma functionalization under different pressure and power conditions was used to modify their surface chemistry through the controlled incorporation of oxygen-containing groups[3]. The effects of growth conditions and water plasma functionalization were examined by SEM, Raman and X-ray photoelectron spectroscopies, cyclic voltammetry (CV), and electrochemical impedance Spectroscopy (EIS). Results demonstrated that alterations in growth conditions and water-plasma treatment strongly influenced the structural order and defect density of the nanowalls. Raman analysis showed that variations in the growth gas mixture affected structural disorder and crystallinity, while plasma power determined whether water-plasma treatment promoted oxygen functionalization or etching. Finally, water plasma treatment resulted in a 1.4-fold increase in the double-layer capacitance (Cdl) from 5.44 to 7.66 mF $cm^{-2}$, indicating increased electrochemically accessible surface area.

## References

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[3] Hussain, S.; Amade, R.; Jover, E.; Bertran, *Nanotechnology* **2012**, *23* (38), 385604.

## Figures

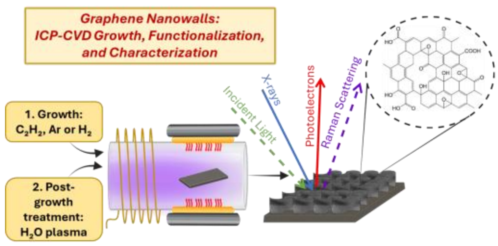


**Figure 1:** Schematic illustration of ICP-CVD, functionalization and characterization of GNWs.