In-situ-prepared protective seed layer by plasma ALD on graphene

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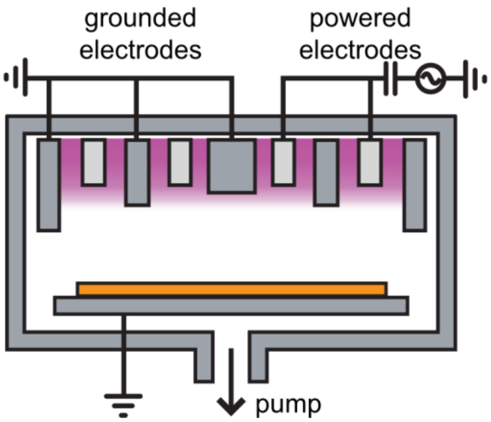
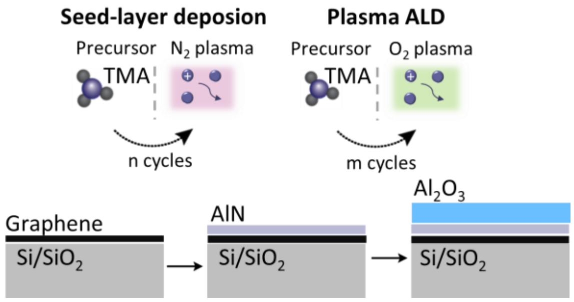
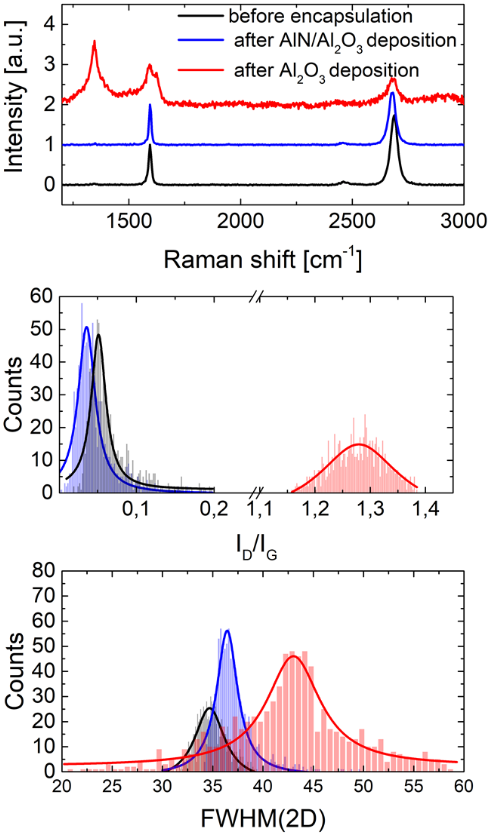


A side view schematic of Atomfab's plasma source [patent application PCT/GB2019/052763]. This remote plasma method was used for low damage deposition of both the protective AlN layer and the Al_2O_3 dielectric.



Process scheme of AlN seed-layer deposition and Al_2O_3 plasma ALD. The remote nitrogen plasma with a low plasma dose prevents etching of graphene while ensuring its physical/chemical modification. The thin layer of AlN provides an efficient protection of the graphene against the O_2 plasma during Al_2O_3 encapsulation.



Raman spectra and related metrics to indicate negligible damage when using the combination of protective seed layer and plasma ALD Al_2O_3. Parameters I_D/I_G and FWHM (2D) for Gr/SiO_2/Si wafers before (black) and after Al_2O_3 deposition, with (blue) and without (red) AlN seed-layer. The sample protected by the AlN seed layer shows a negligible D-peak (no damage). The sample encapsulated by PEALD without AlN shows a significant increase in the I_D/I_G due to the induced damage to the graphene lattice by O_2 plasma exposure. A low FWHM(2D) for the wafer protected by the AlN seed layer corresponds to small strain variations.