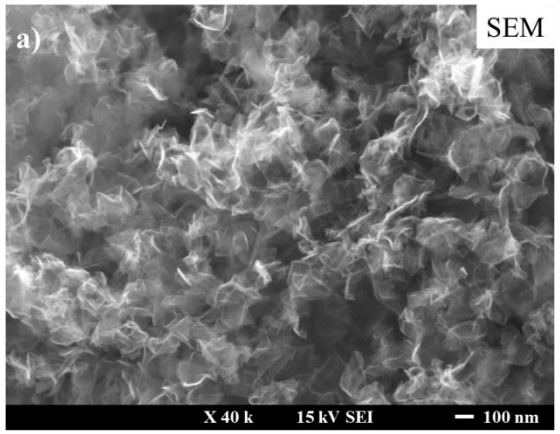
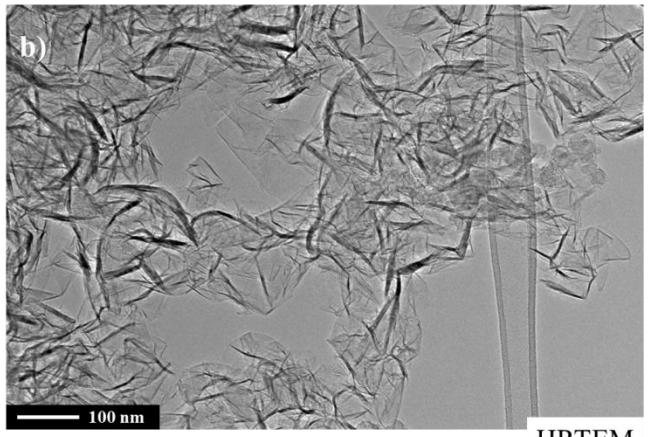
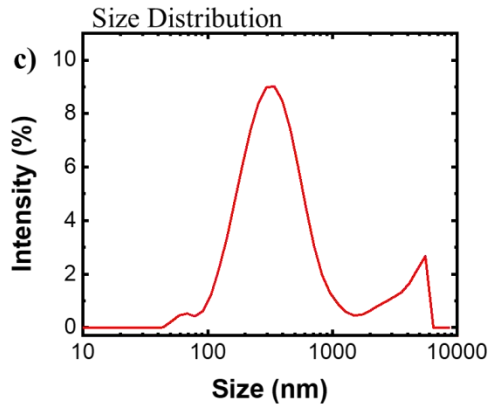
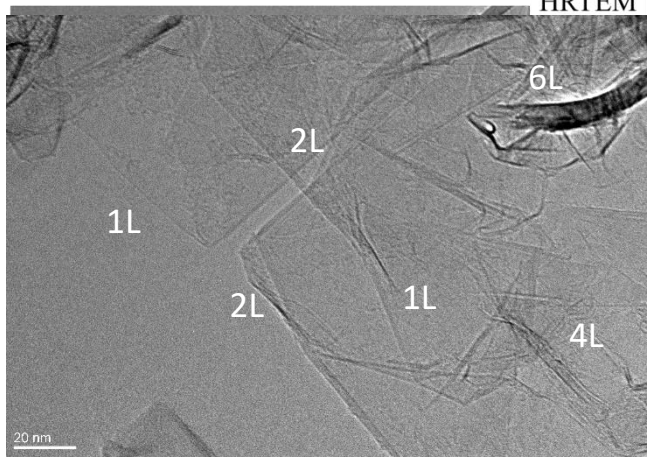
# Pristine graphene

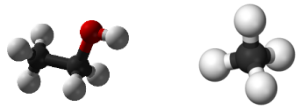


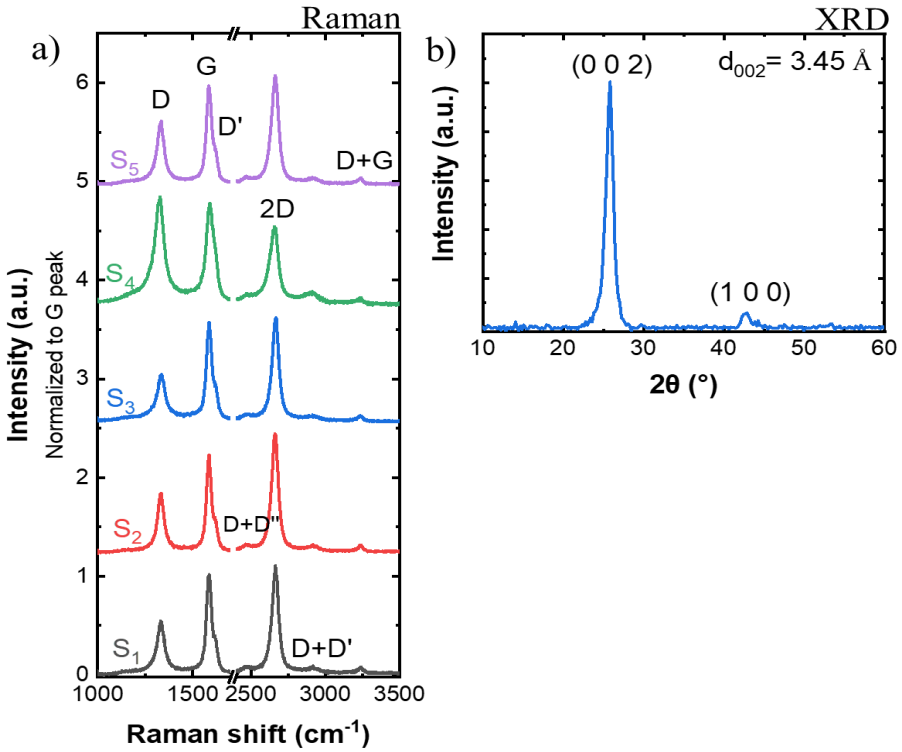

**Carbon precursors**



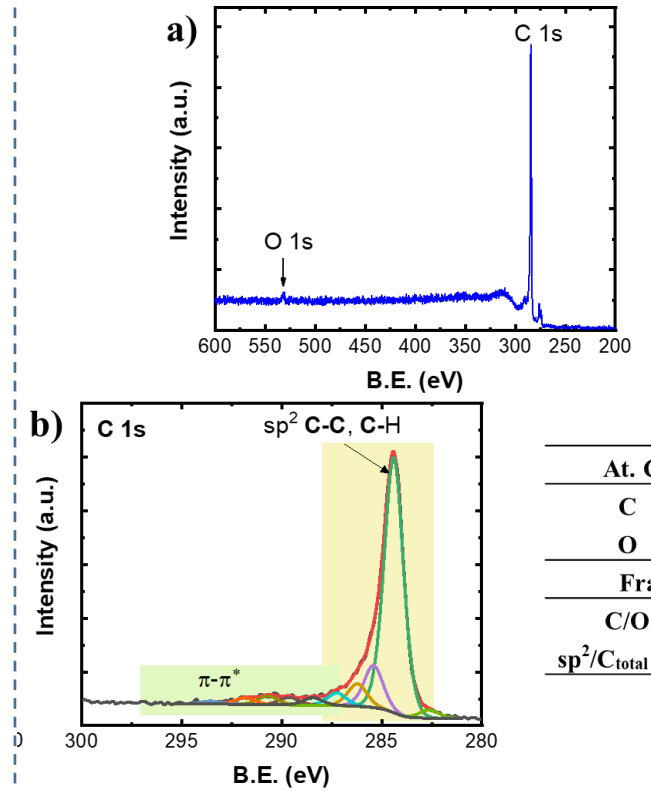
***a) SEM, b) TEM, d) HRTEM images of graphene produced with ethanol, c) size distribution of the sheets.***

**Production of high-quality graphene at yield *10- 30 mg/min.***

# Pristine graphene




*a) Raman spectra collected from different locations of the sample, b) XRD pattern of graphene produced with ethanol.*

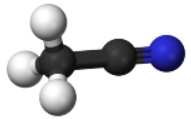


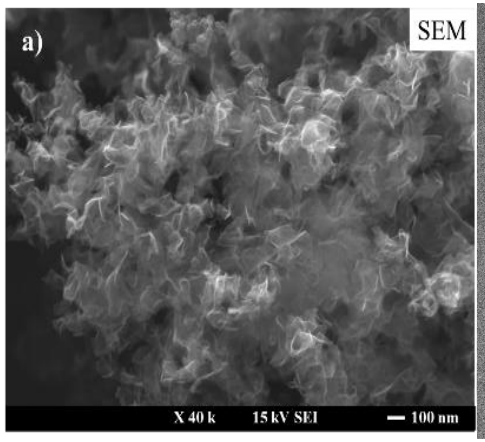

| At. Conc. % | |
|---|---|
| C | 98.0 |
| O | 1.5 |
| **Fractions** | |
| C/O | 65.3 |
| $sp^2/C_{total}$ (%) | 68 |

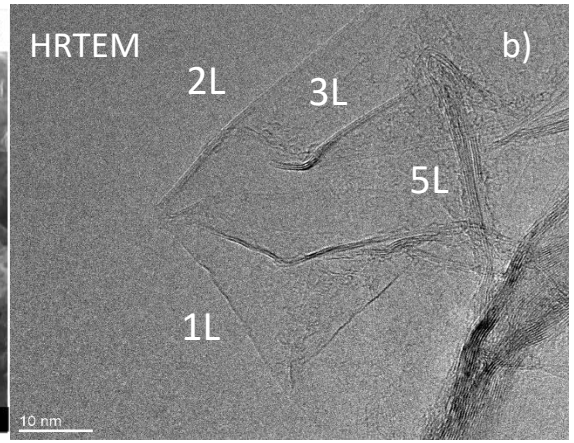
*XPS survey and C 1s spectra of graphene produced with ethanol and compositions analysis*

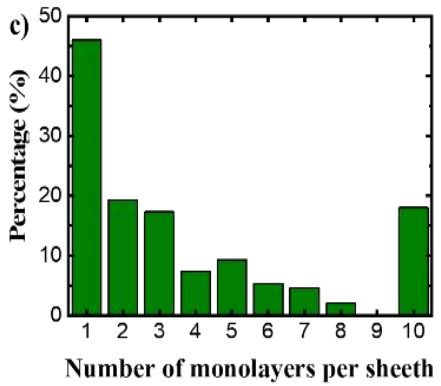
# Free-standing N-graphene sheets fabrication

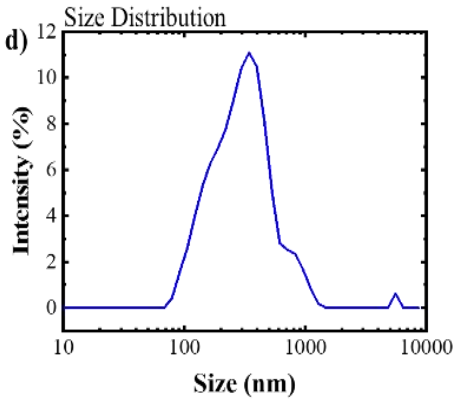
## *Acetonitrile in laminar injection*

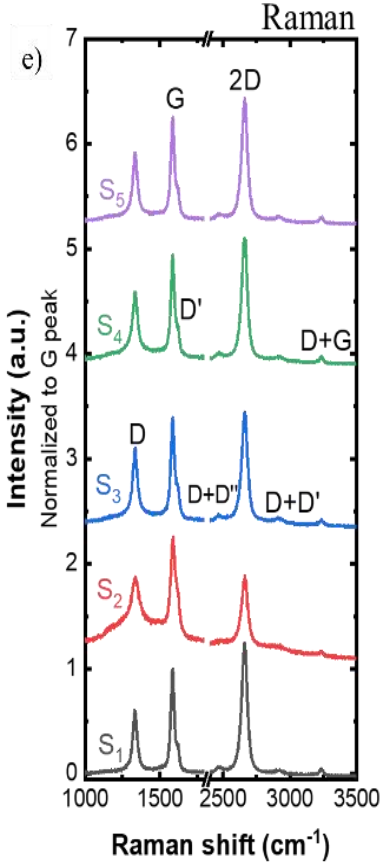


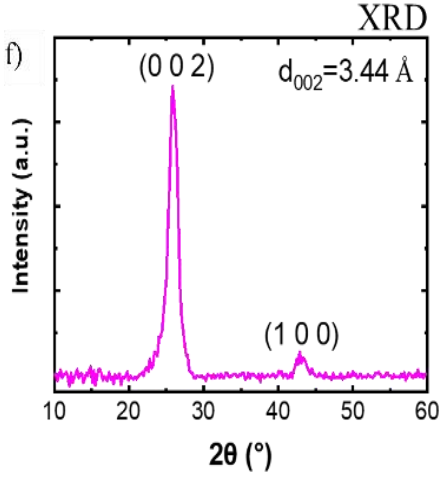


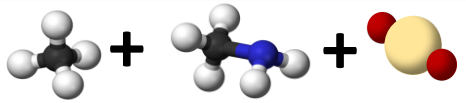



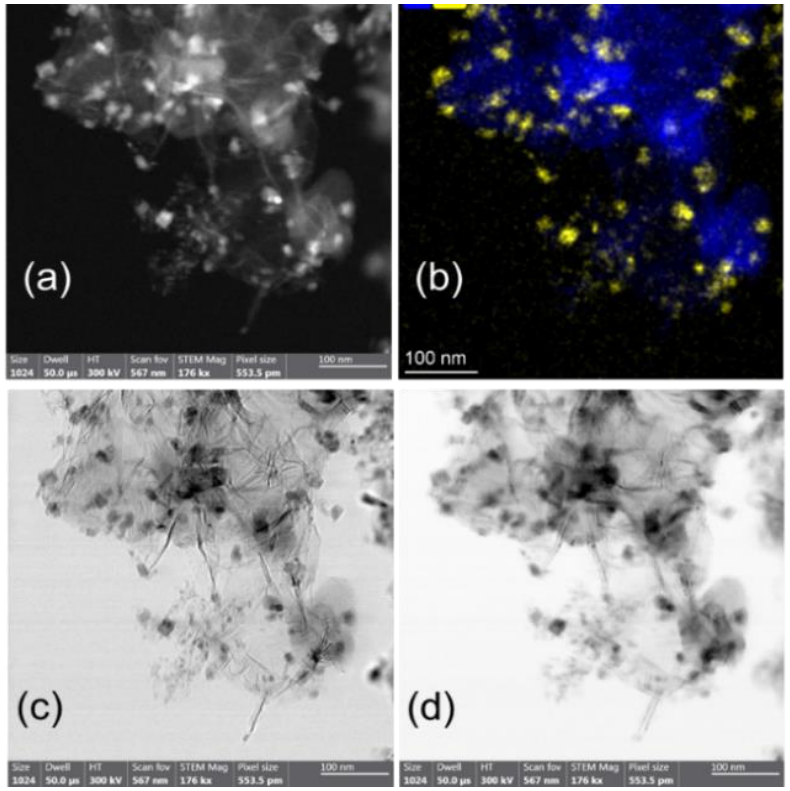

| At. Conc.% | |
|---|---|
| C | 95 |
| N | 2.8 |
| O | 2.2 |
| Fractions | |
| C/O | 43.2 |
| $Sp^2/C_{total}$ % | 67 |

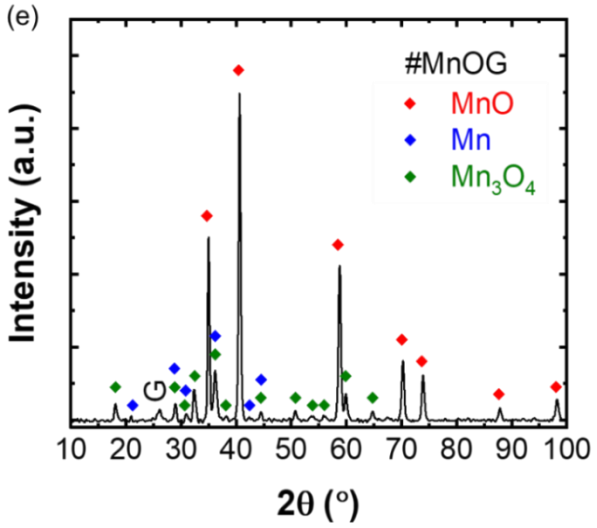
***a) SEM and b) HRTEM images of N-graphene sample, c) number of monolayers per sheet estimated from HRTEM images' analysis, d) size distribution of the sheets, e) Raman spectra collected from different locations; f) XRD pattern***

**Production of high-quality N-graphene at yield *30 mg/min.***

# N-Graphene based hybrid nanostructures

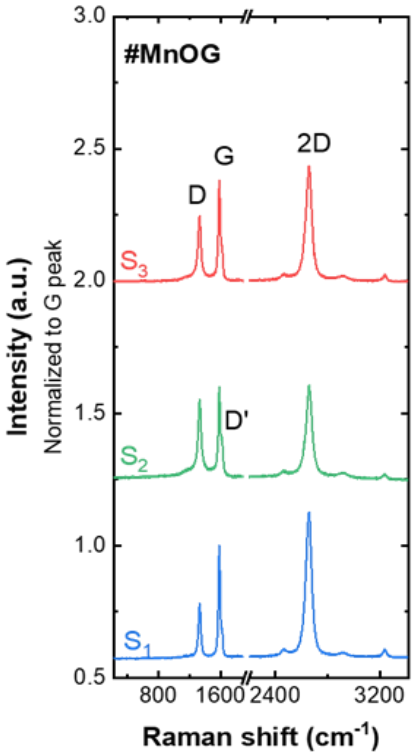





XPS

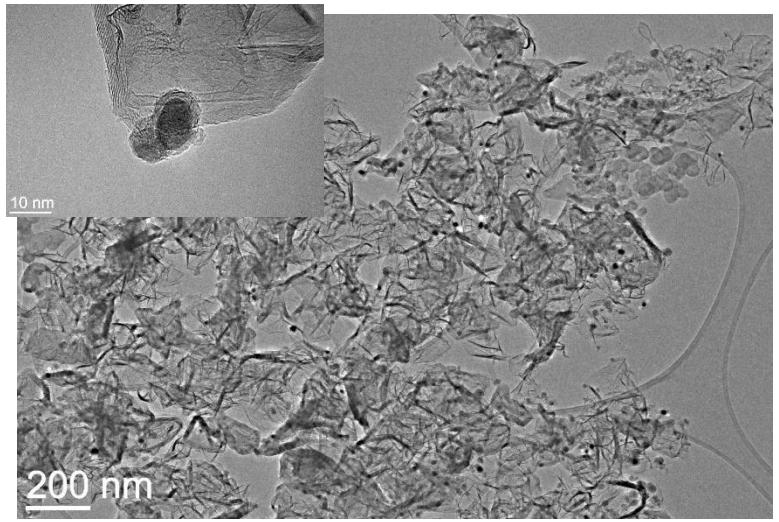
| Atomic concentrations (%) | |
|---|---|
| C | 75.7 |
| O | 15.9 |
| N | 1.1 |
| Mn | 7.3 |



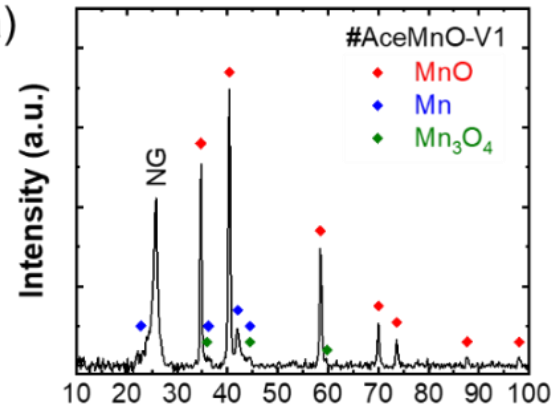

***STEM-(a) HAADF and (c, d) BF images of the N-graphene/Manganese oxide hybrids and corresponding (b) EDS mapping of the elemental distribution of C (blue) and Mn (yellow). (e) respective XRD pattern.***

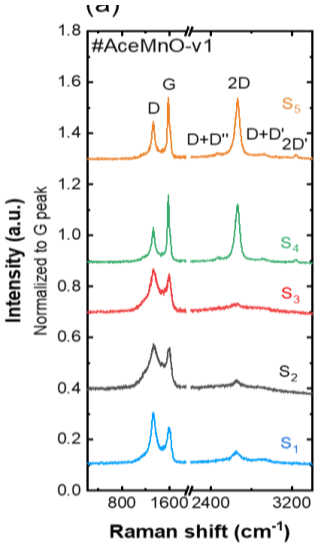
***The developed plasma-based method enables not only the synthesis of N-Graphene-metal oxide nanocomposites but also the conversion of micron-sized $MnO_2$ particles into nano sized MnOx particles, mainly MnO and $Mn_3O_4$ nanoparticles.***

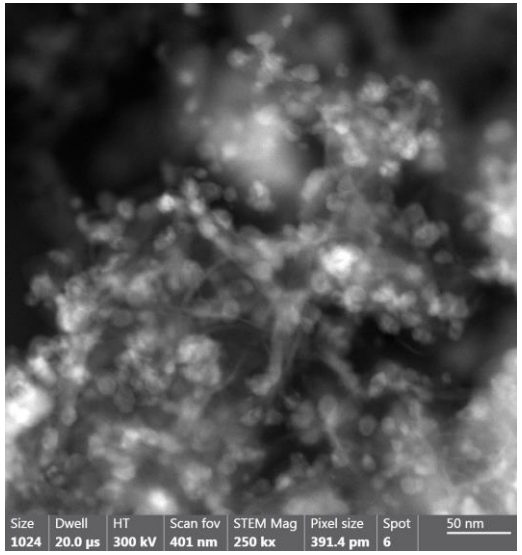
# N-Graphene based hybrid nanostructures

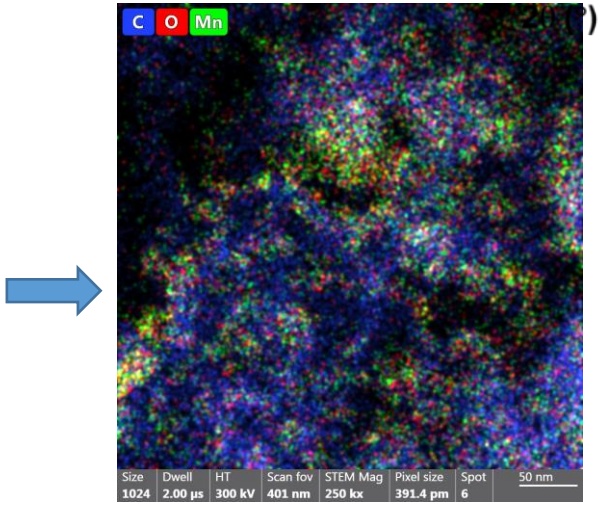


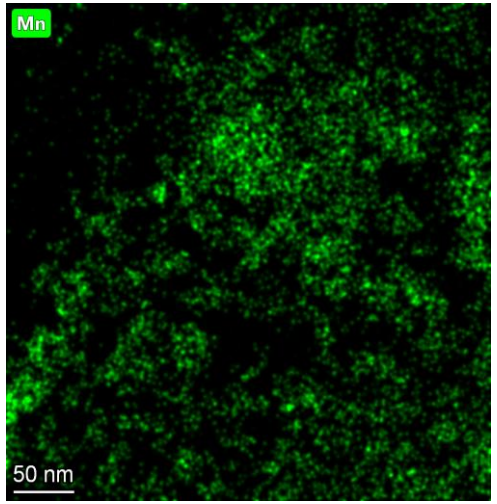

*Acetonitrile in swirl injection*




***STEM-DF image and respective EDS map of the synthesised hybrid nanostructures.***