# Detection of graphene in air

## A proposal based on thermal properties


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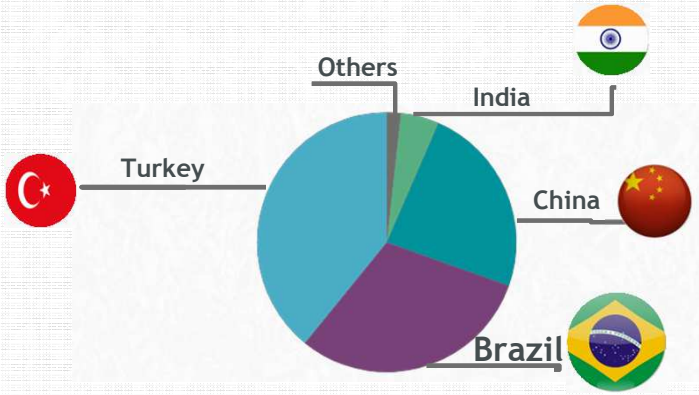
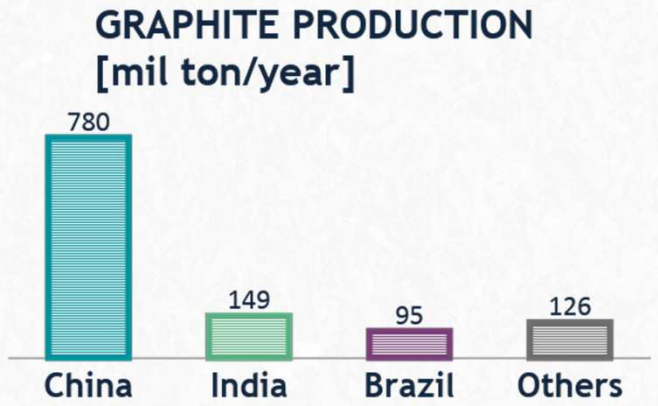
# BRAZILIAN GRAPHITE

- 2° WORLD RESERVE

- 3° WORLD PRODUCER

TOTAL WORLD PRODUCTION= 270 millions ton




*Data source: U.S. Geological Survey, Mineral Commodity Summaries, January (2018)*

# PROJECT MGGRAFENO

## FROM NATURAL GRAPHITE TO GRAPHENE

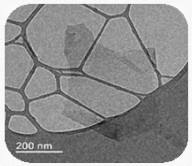
**+150 kg/year**

INSTALLED CAPACITY

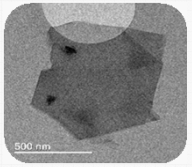
**+40** COLABORATORS

**3** PRODUCTS

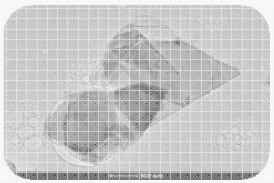
GRAPHENE (1-5)




GRAPHENE (6-10)




GRAPHITE
NANOPLATELET



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**$5.3 MI**

INVESTED

## APLICATIONS

DEVELOPMENT



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# EHS

ENVIROMENT, HEALTH AND SAFETY

**100%**

LIQUID WASTE TREATMENT

**AIR** 100%

CONFORMITY

ZERO ACCIDENT

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## AIR MONITORING (INDOOR AND OUTDOOR) IN ACCORDANCE WITH BRAZILIAN ENVIRONMENTAL LEGISLATION*

***CONAMA 03/1990**

Hi-Vol samplers used in course of routine monitoring activities

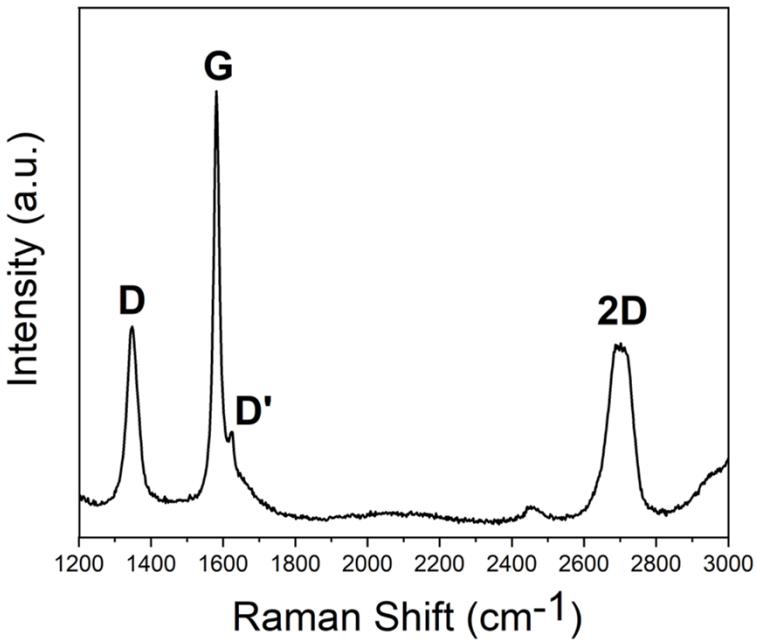
# OUR GRAPHENE (1-5)

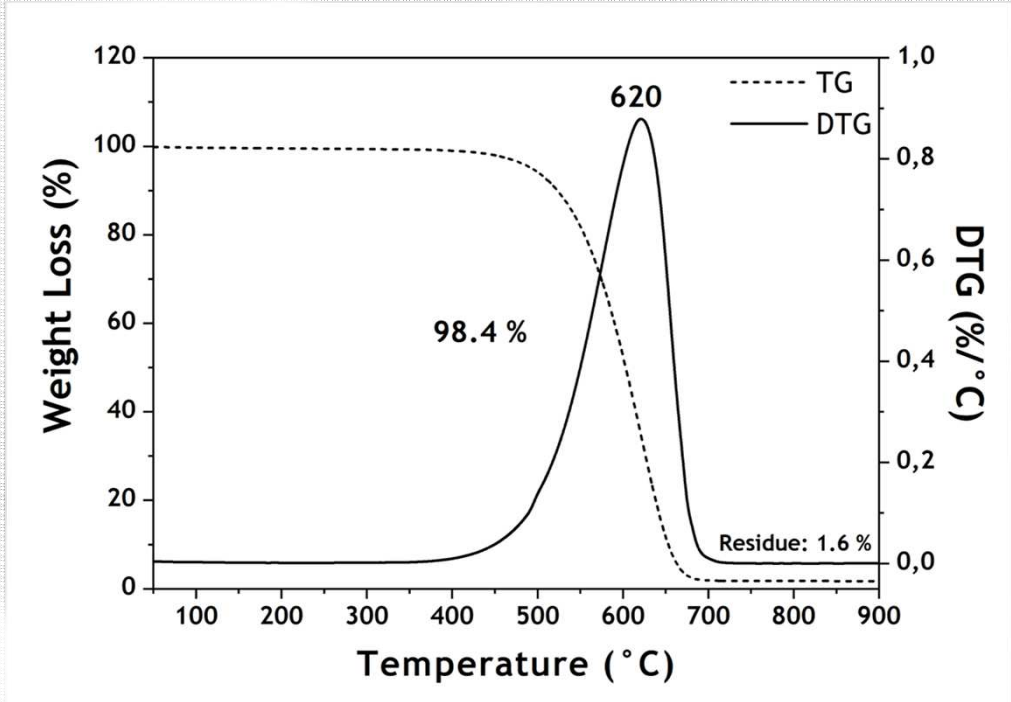
## FEWLAYER GRAPHENE

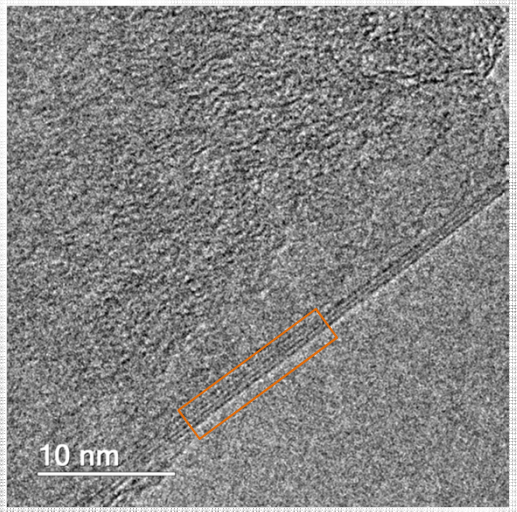
N: 1-5

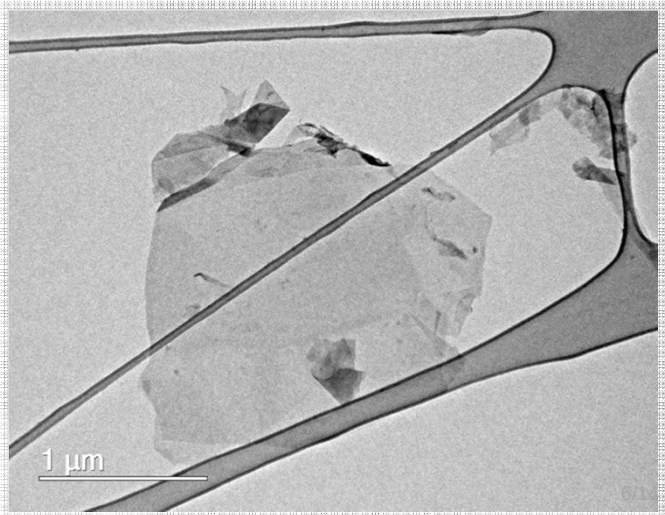
COMBUSTION TEMP.= 620°C

PURITY= ~98.5%



# DEVELOPMENT OF A METHOD TO DETECTED GRAPHENE DIRECT IN THE AIR COLLECTING FILTERS

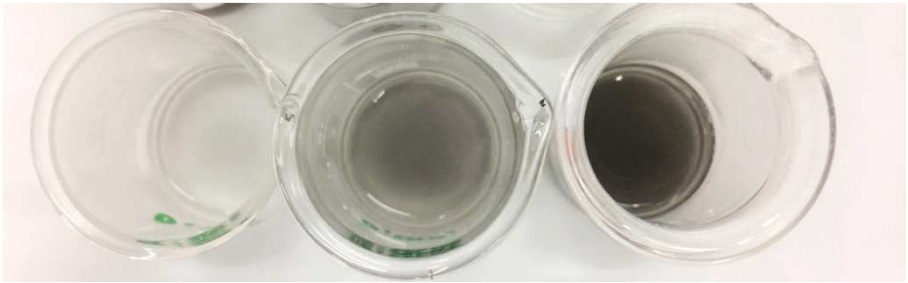
## Why TGA?

**Allows quantification | Good for complex matrices | No special sample preparation needed**

# METHODOLOGY

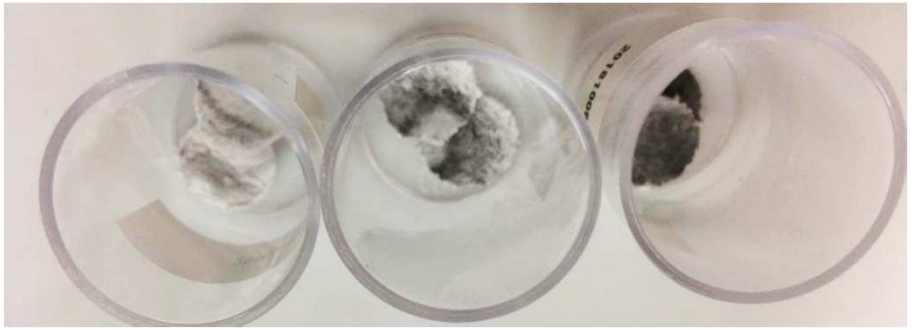
STANDARDIZED STUDY

**DISPERSIONS AND FILTER PREPARATION**



**DEPOSITED VIA FILTRATION**

1mg/mL; 0.1mg/mL; 0.01mg/mL



**THERMOGRAVIMETRIC ANALYSIS**

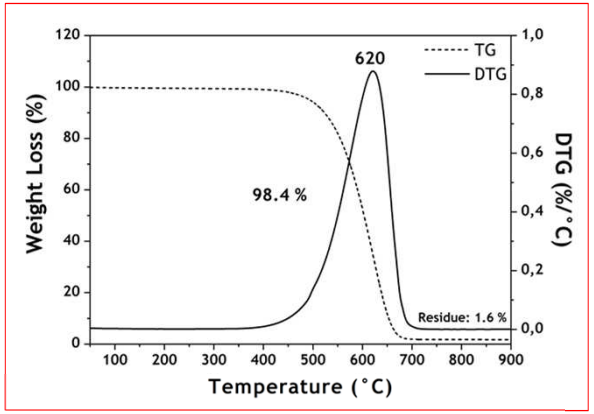
40°C to 1000°C

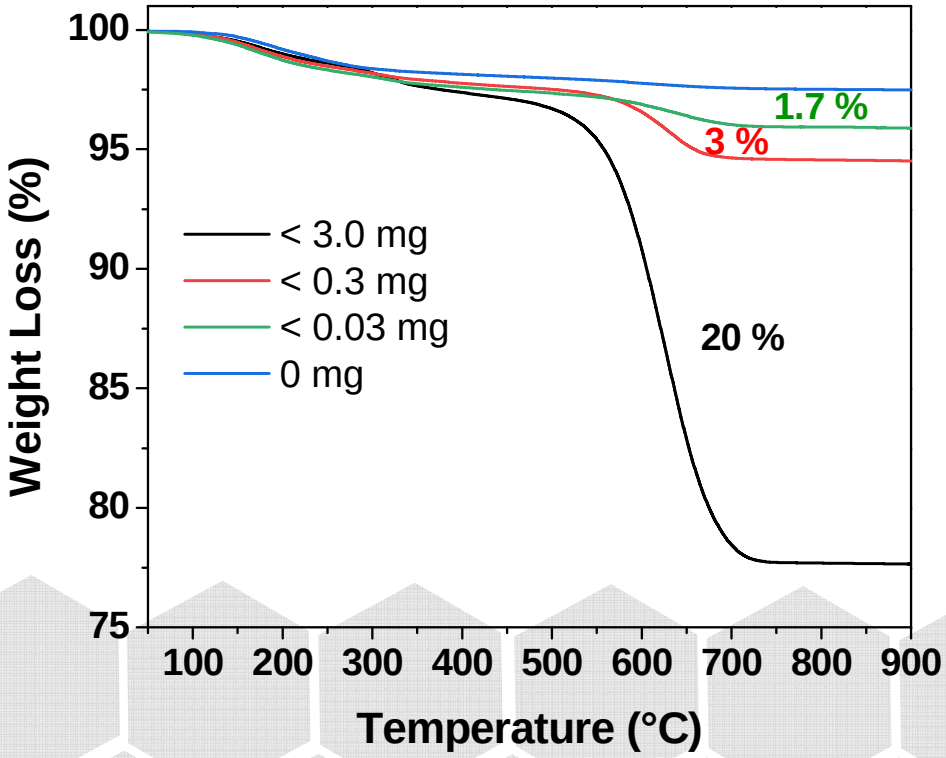
# RESULTS

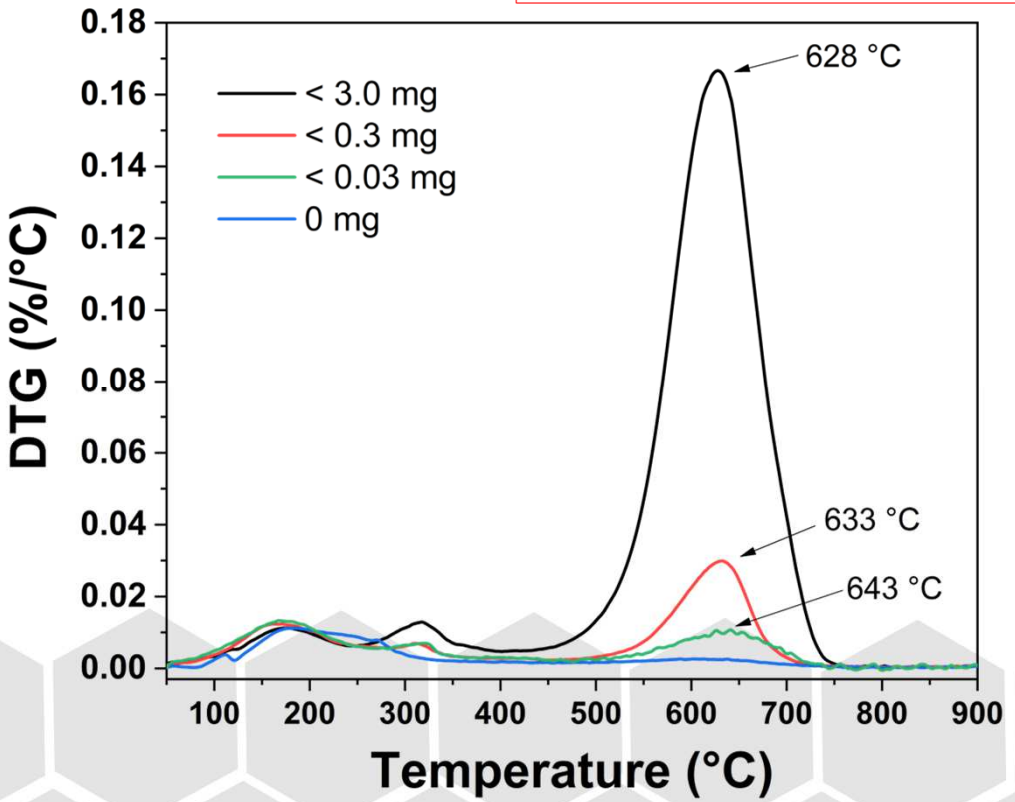
## STANDARDIZED STUDY

Thermal analysis presented a decomposition range typical of few-layer graphene

Control filters (0 mg/mL) thermally almost stable with weight loss of approximately 2%



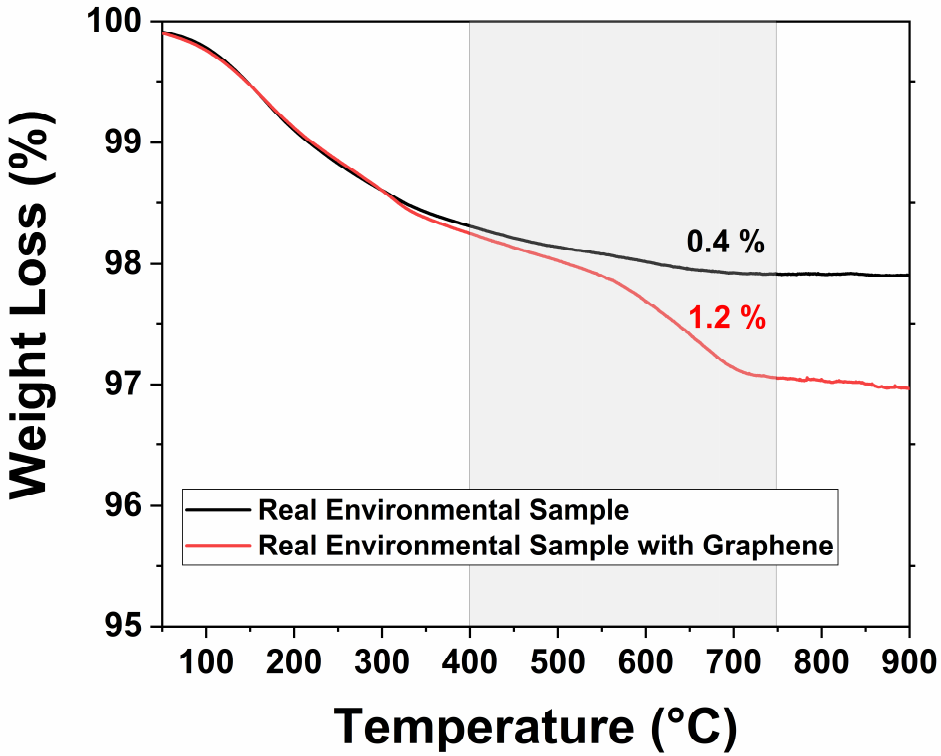



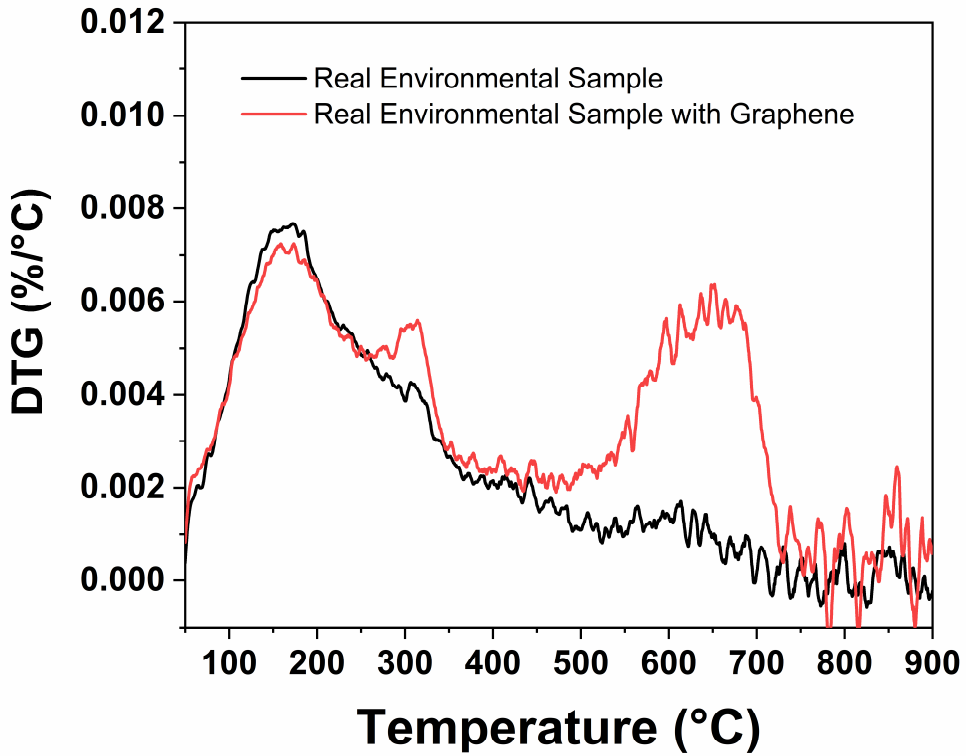



# RESULTS

## STANDARDIZED STUDY

- The weight loss of filters loaded with diferent types of particulate matter (environmental/outdoor sampling) ocurrs until ~400°C
- The presence of graphene added a new decomposition event in the temperature range of 400 – 750°C



# RESULTS

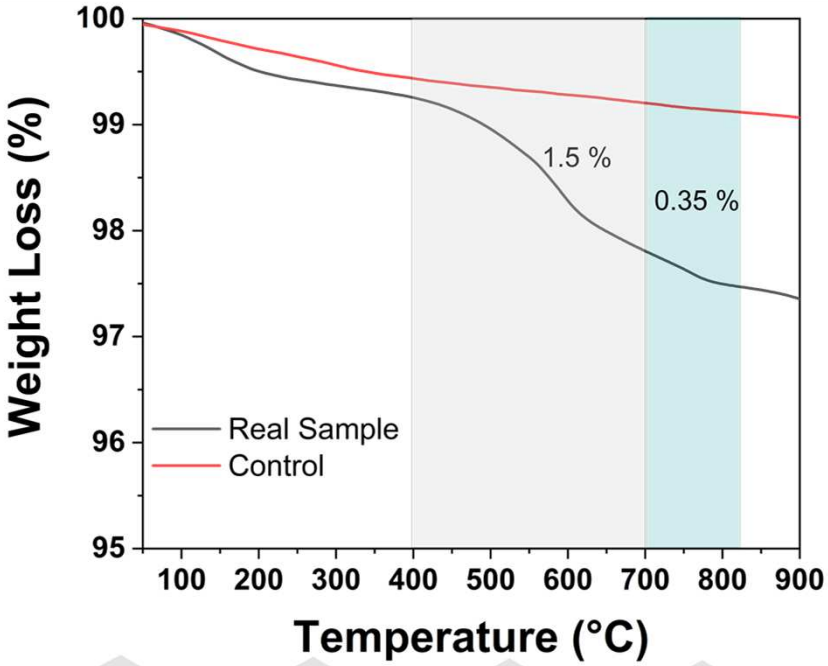
REAL SAMPLE TEST

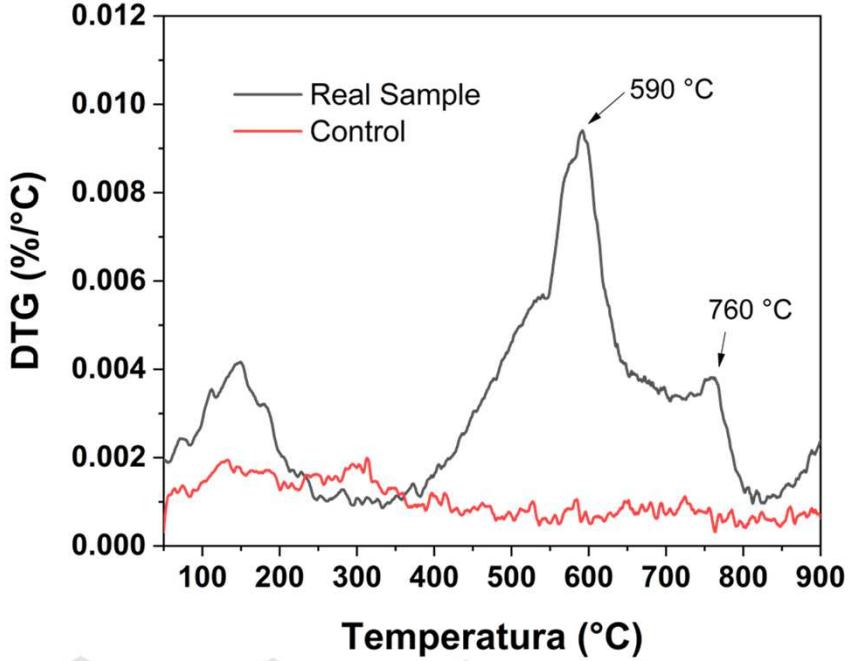
**FILTER PREPARATION**
precleaned (muffle furnace)

**AIR SAMPLING (Hi-Vol)**
24h of exposure

**THERMOGRAVIMETRIC ANALYSIS**
10°/min; synthetic air

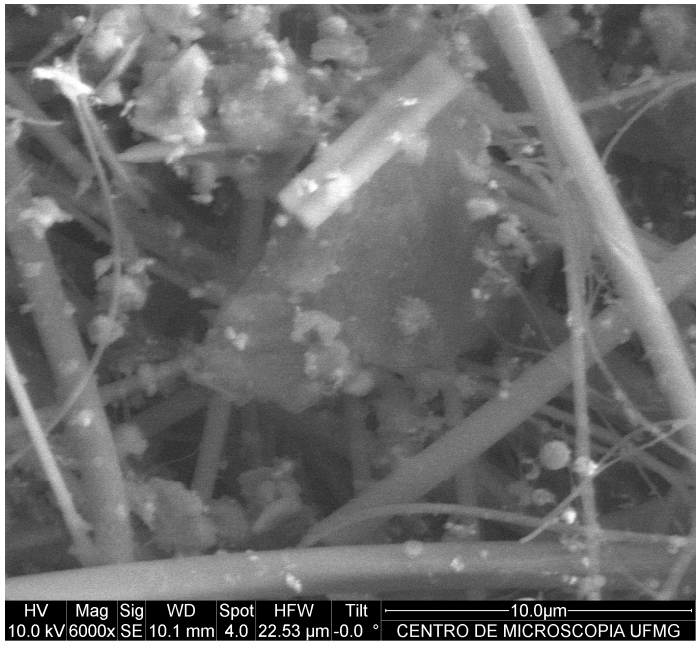
Presence of a thermal decomposition event in the same temperature range of graphene

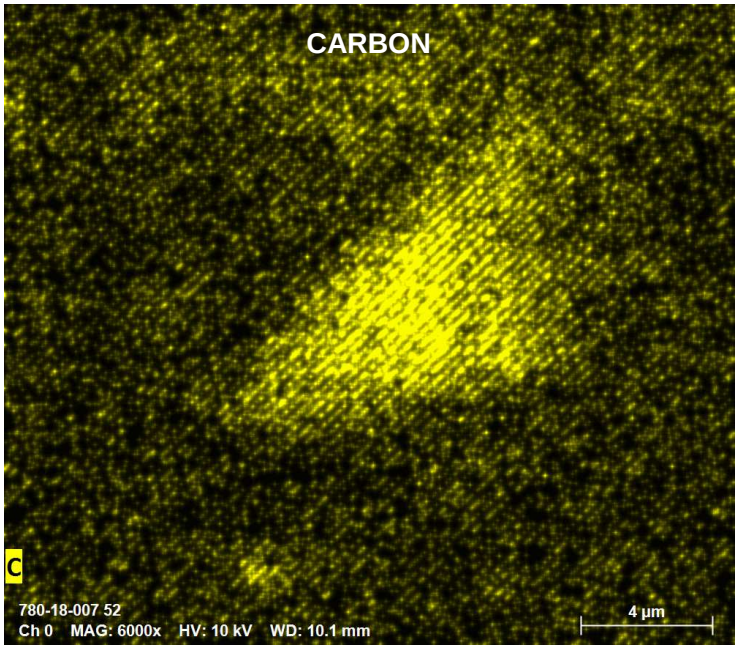


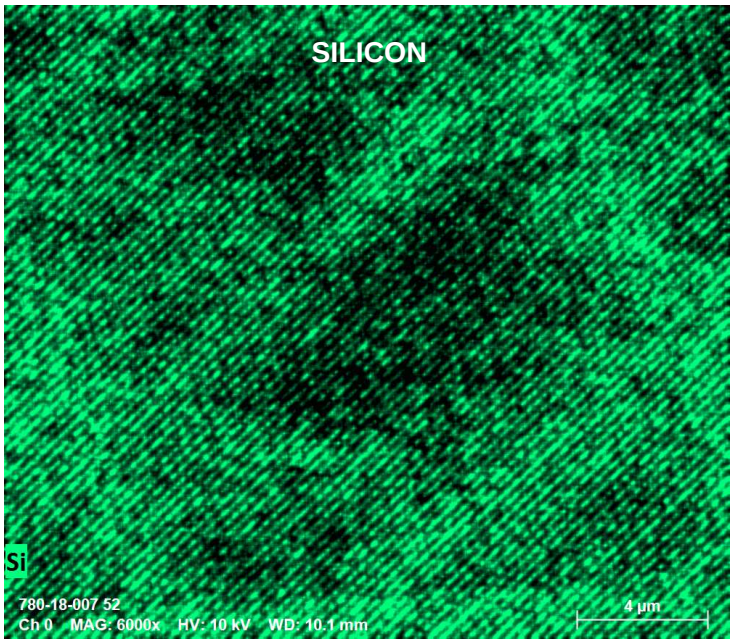



# RESULTS

## REAL SAMPLE TEST



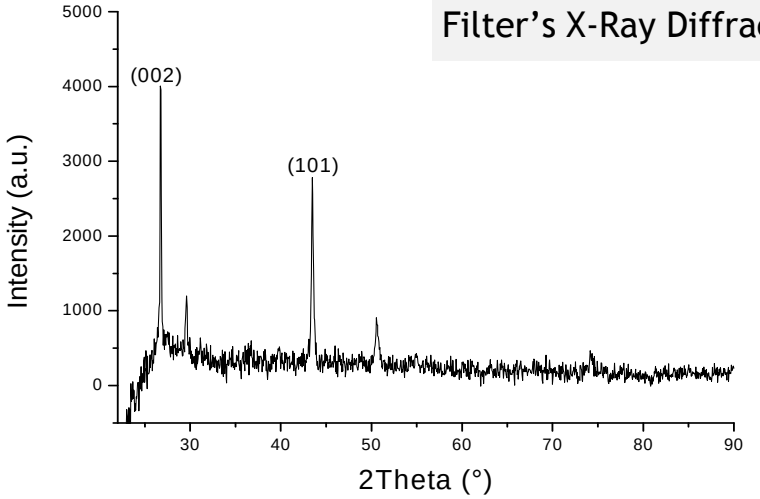




Filter's Scanning Electron Microscopy with Energy Dispersive Spectroscopy

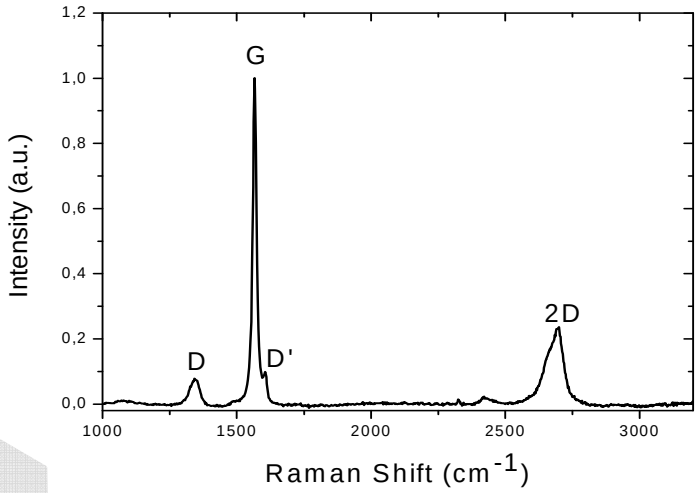
# RESULTS

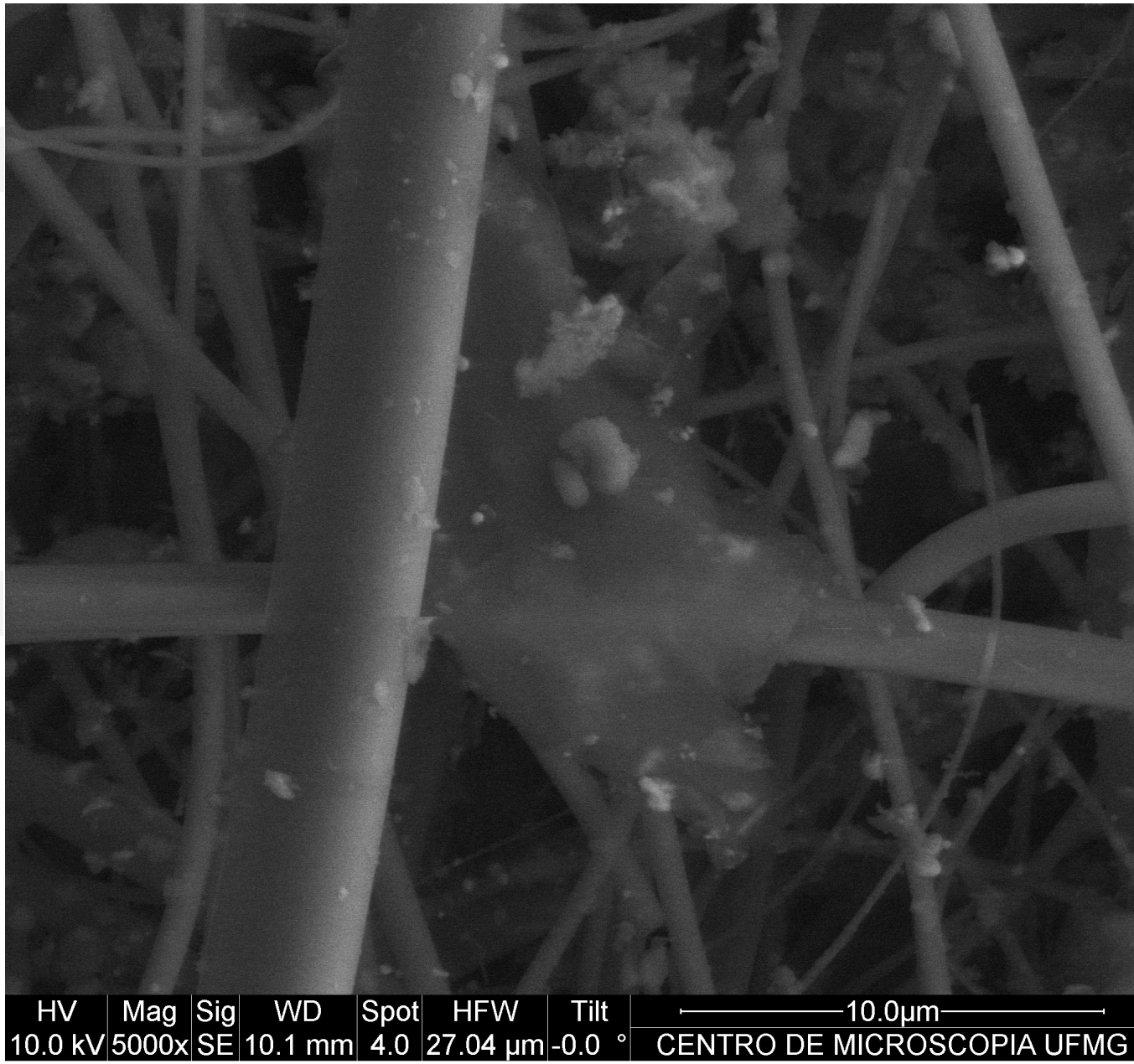
## REAL SAMPLE TEST

### Filter's X-Ray Diffraction




### Filter's Raman Spectroscopy



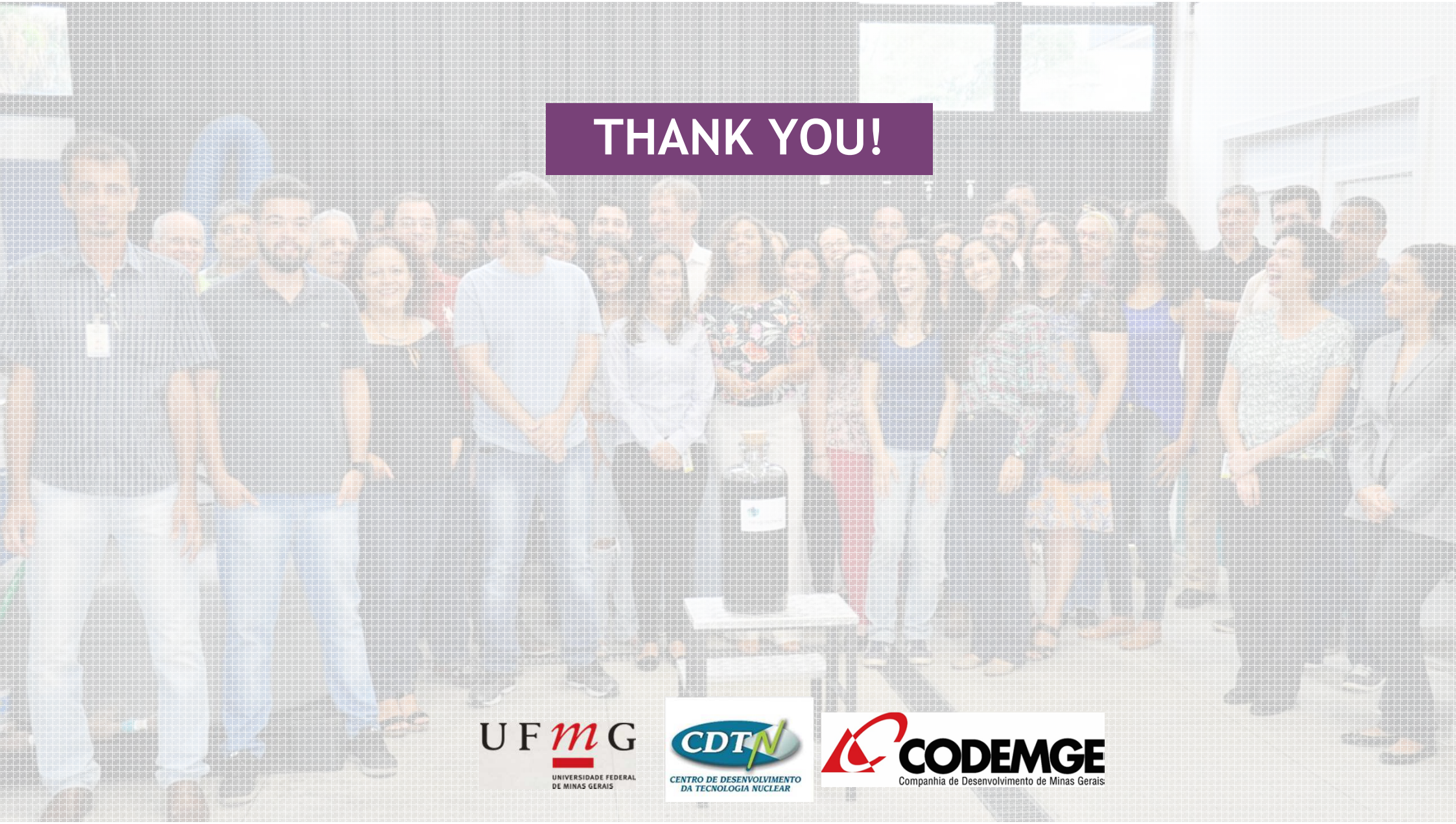
# CONCLUSIONS

✓ The thermogravimetric analysis can be used to **detect** small amounts of graphene deposited on the filters

✓ It was also possible to **detect** graphene in real samples, after indoor particulate matter sampling at the MGgrafeno pilot production plant

NEXT STEPS

Is possible to estimate or quantify, and to differentiate graphene/graphite exposition by using TGA analysis?



# THANK YOU!

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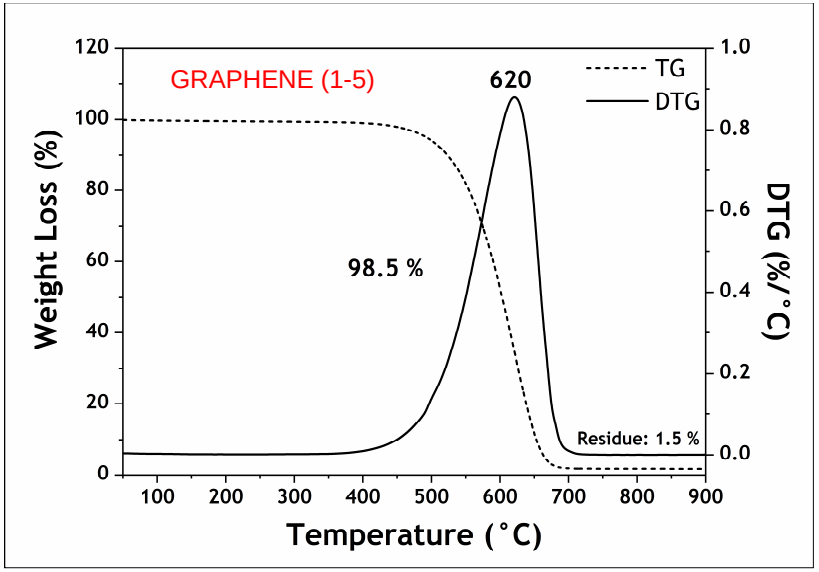
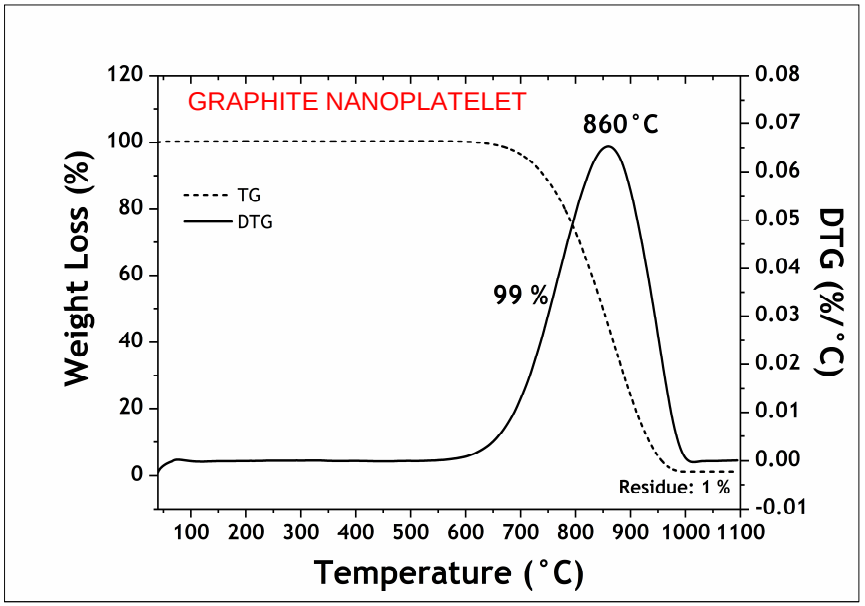
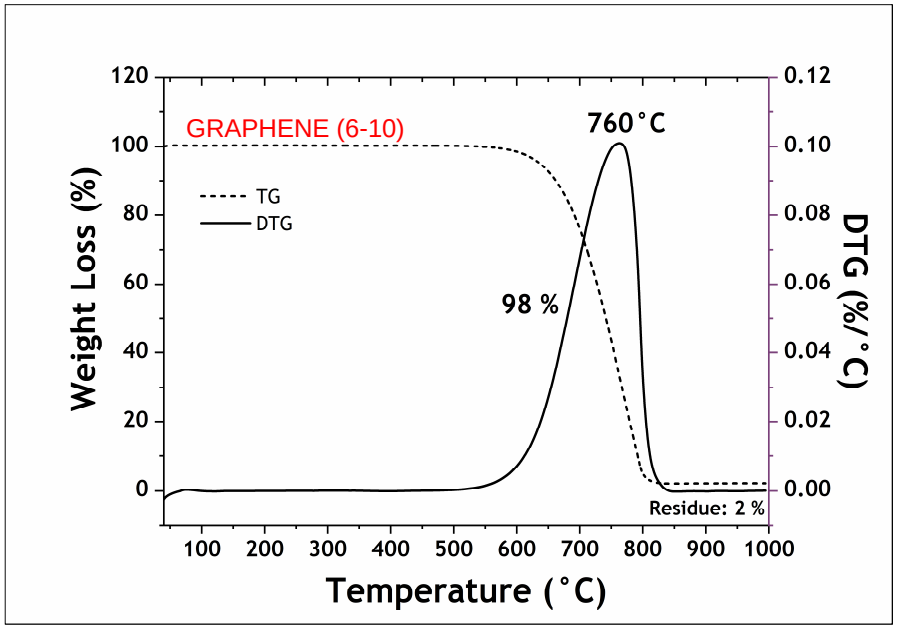
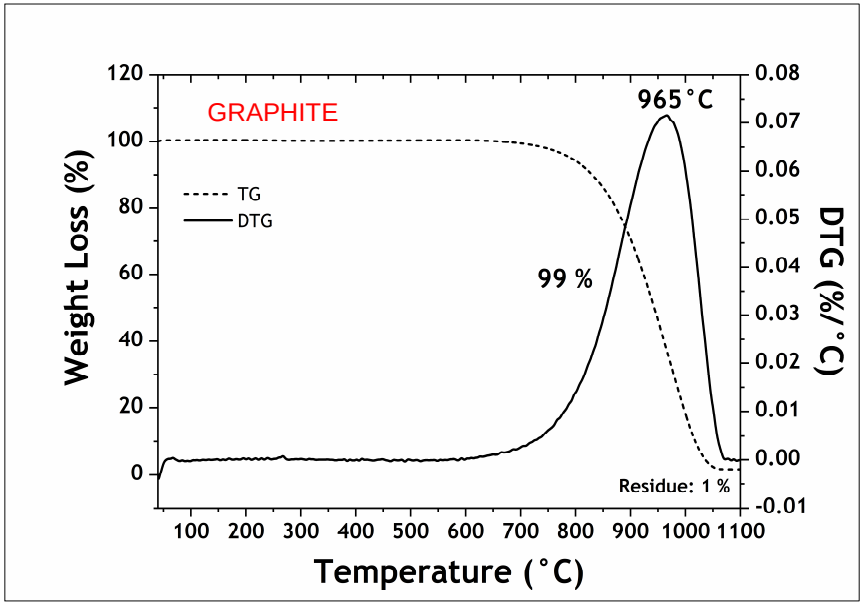

GRAPHENE (1-5)
620
TG
DTG
98.5 %
Residue: 1.5 %
Weight Loss (%)
DTG (%/°C)
Temperature (°C)


GRAPHITE NANOPLATELET
860°C
TG
DTG
99 %
Residue: 1 %
Weight Loss (%)
DTG (%/°C)
Temperature (°C)


GRAPHENE (6-10)
760°C
TG
DTG
98 %
Residue: 2 %
Weight Loss (%)
DTG (%/°C)
Temperature (°C)


GRAPHITE
965°C
TG
DTG
99 %
Residue: 1 %
Weight Loss (%)
DTG (%/°C)
Temperature (°C)