



Graphene oxide interaction with nitrate esters for novel propellant formulation

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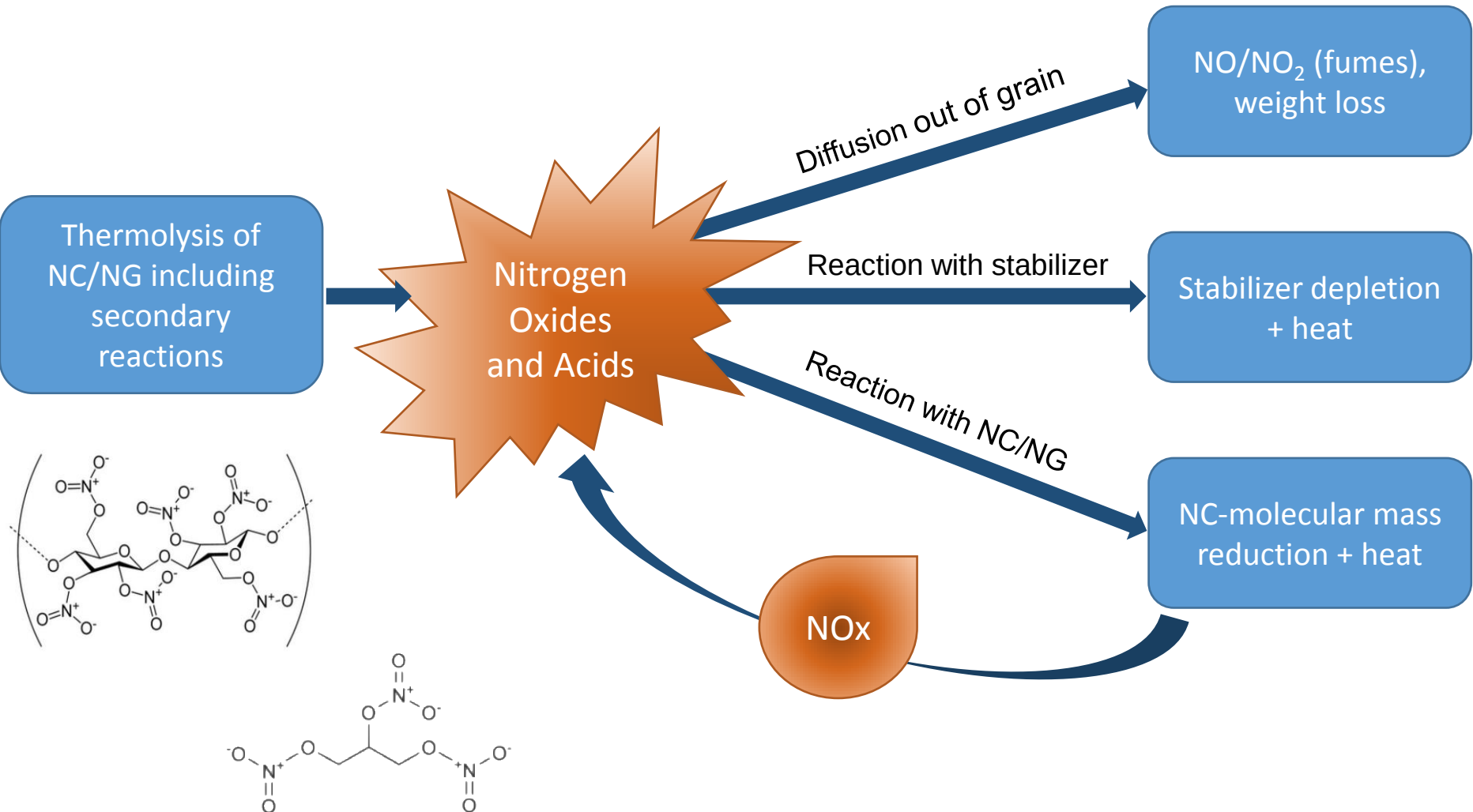


Outlines

1. Introduction
2. Aim
3. Methods
4. Results
5. Conclusion

Introduction

Gun Propellant



Introduction

Need for New Additives

Development of gun propellant:

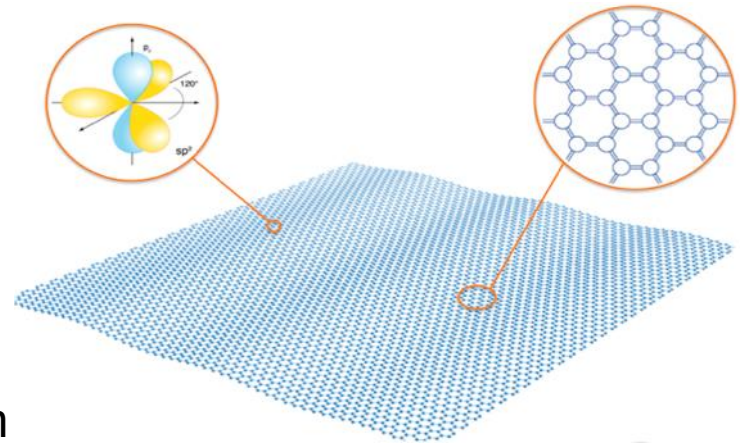
- Improvement of shelf life
- Enhance mechanical properties
- Environmentally-friendly additives
- Improvement of ballistic properties



New Additive - Graphene

(Sing, et al, 2011)

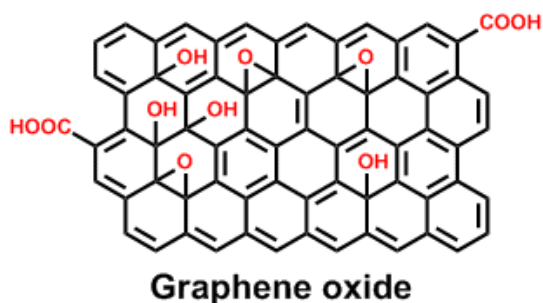
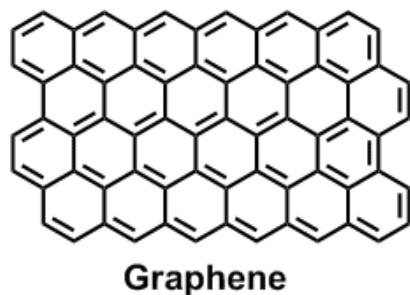
- It was found that graphene is harder than diamond and about 300 times harder than
- The tensile strength of graphene exceeds 1 TPa.
- It is stretchable up to 20% of its initial length.



Graphene Application

Biomedical, Optical Electronic, Energy Storage Devices, Antibacterial, Composite Materials, Chemical sensors, **ENERGETIC MATERIAL**

Graphene with Energetics Materials



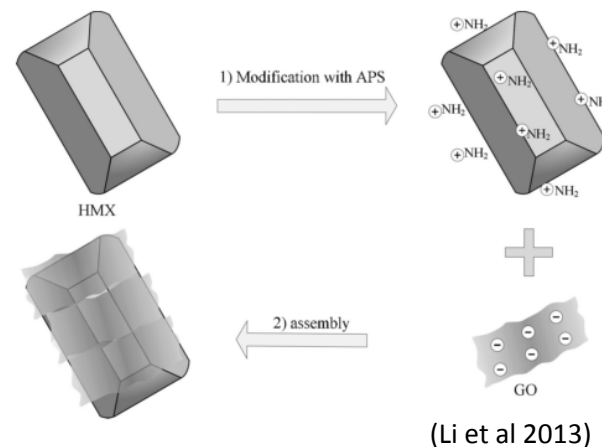
Reduction of **impact sensitivity** of HMX (Li et al 2013)

Increase in **thermal stability** of PETN (Zhang and Weeks, 2015)

increase in **burn rate** of NC films (Zhang et al, 2013)

Increase in **flame speed** in NC (N 10.9%) films (Jain et al, 2013)

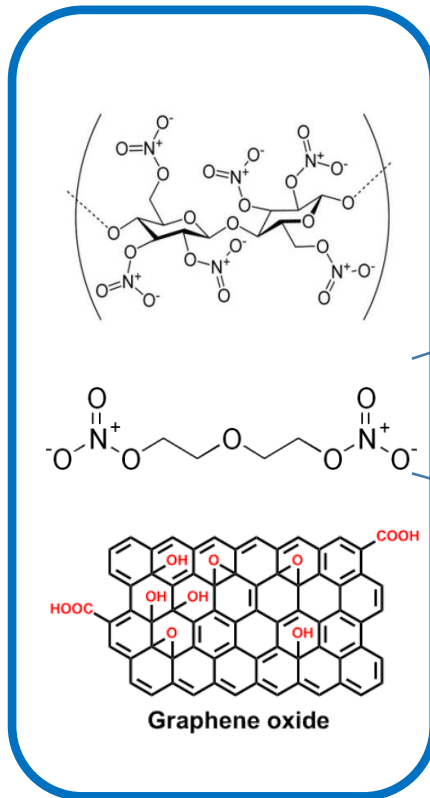
Increase in **anti electrostatic performance** in Lead Styphnate (Li et al 2013)



(Li et al 2013)

Aim of Research

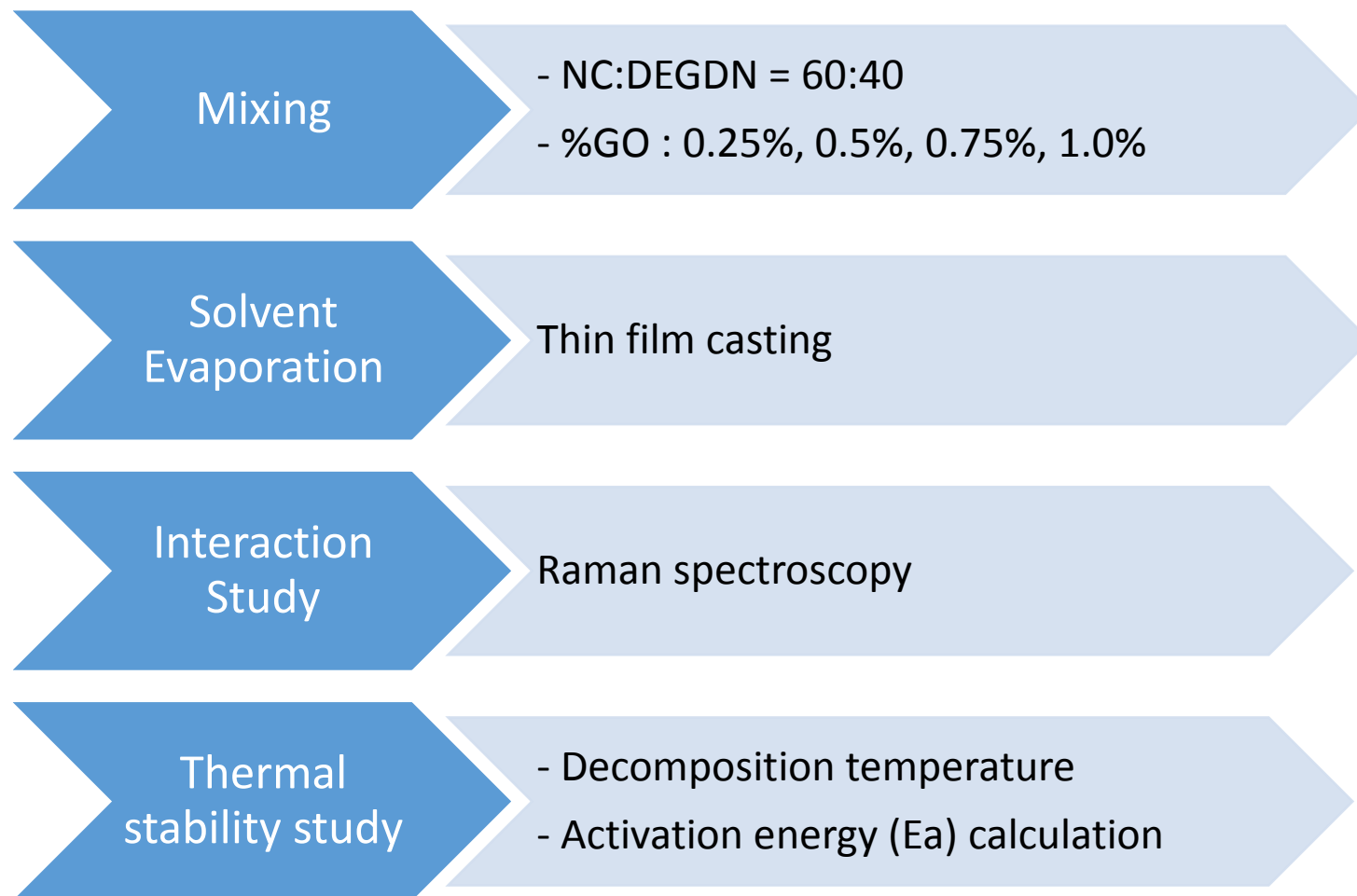
Double Base Propellant Modified with Graphene Nanomaterials



***Interaction of GO in
NC-DEGDN***

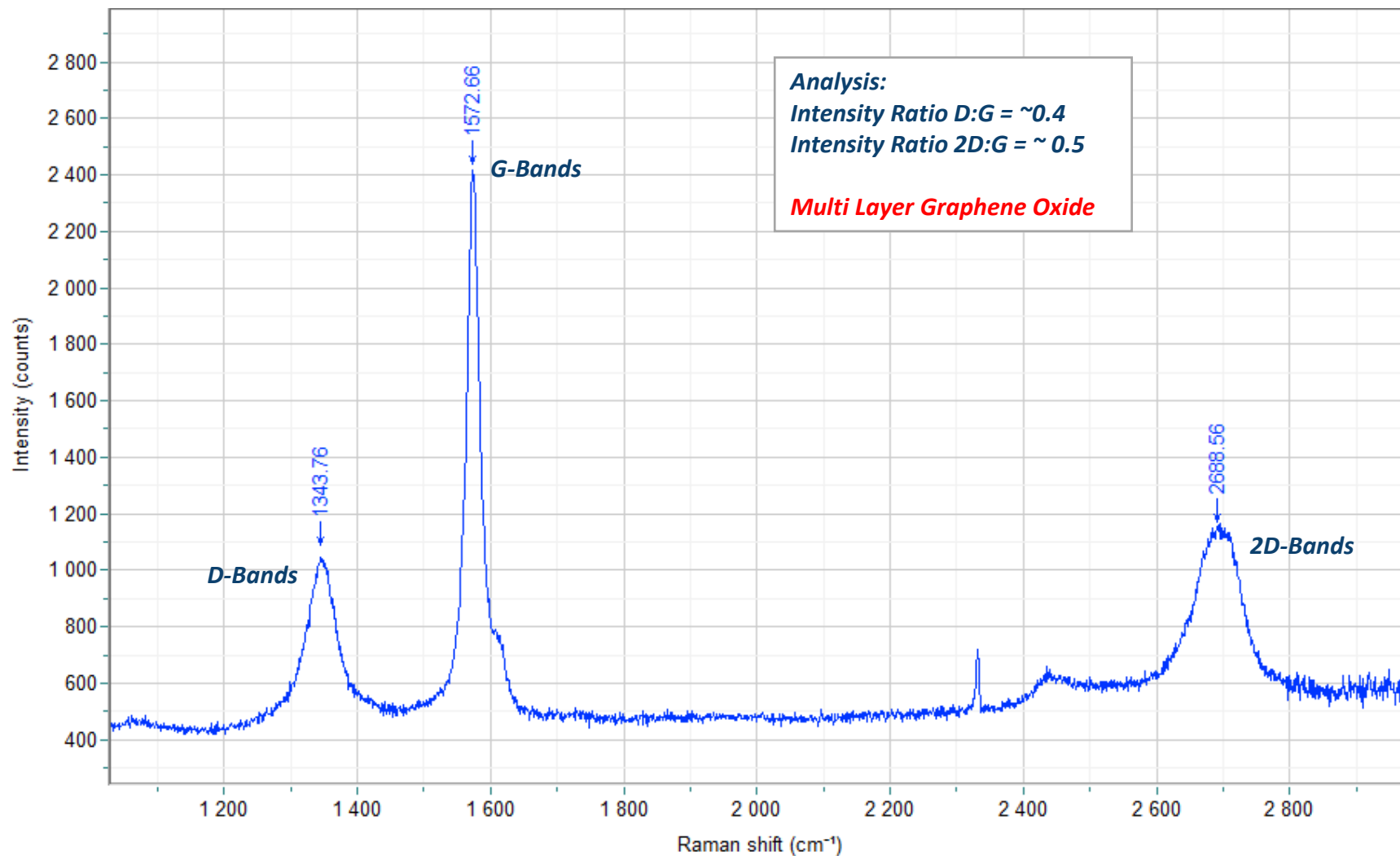
***Thermal stability study NC-
DEGDN doped GO***

Methods



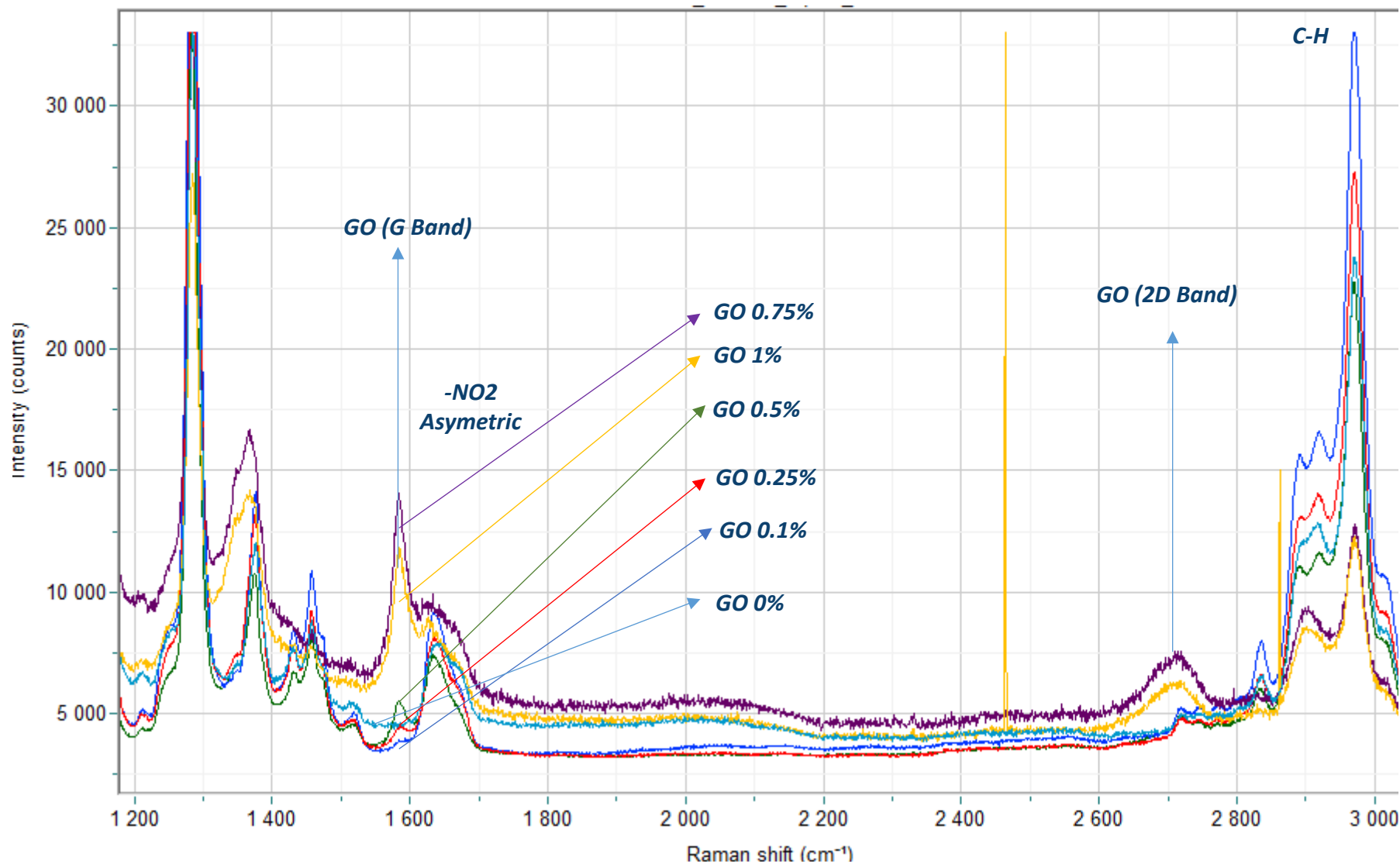
Result

Graphene Oxide Raman Spectra



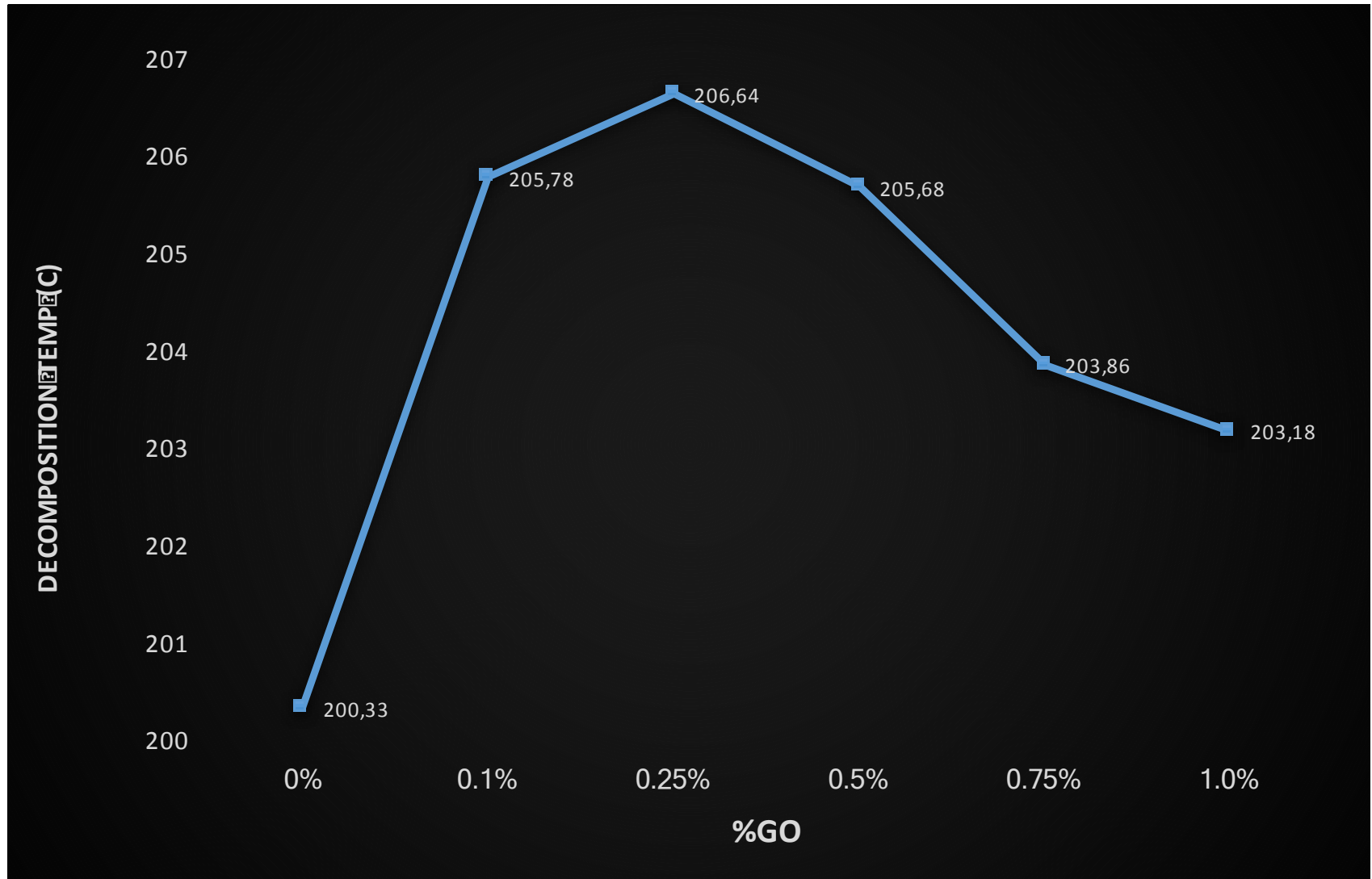
Result

NC/DEGDN-GO Raman Spectra



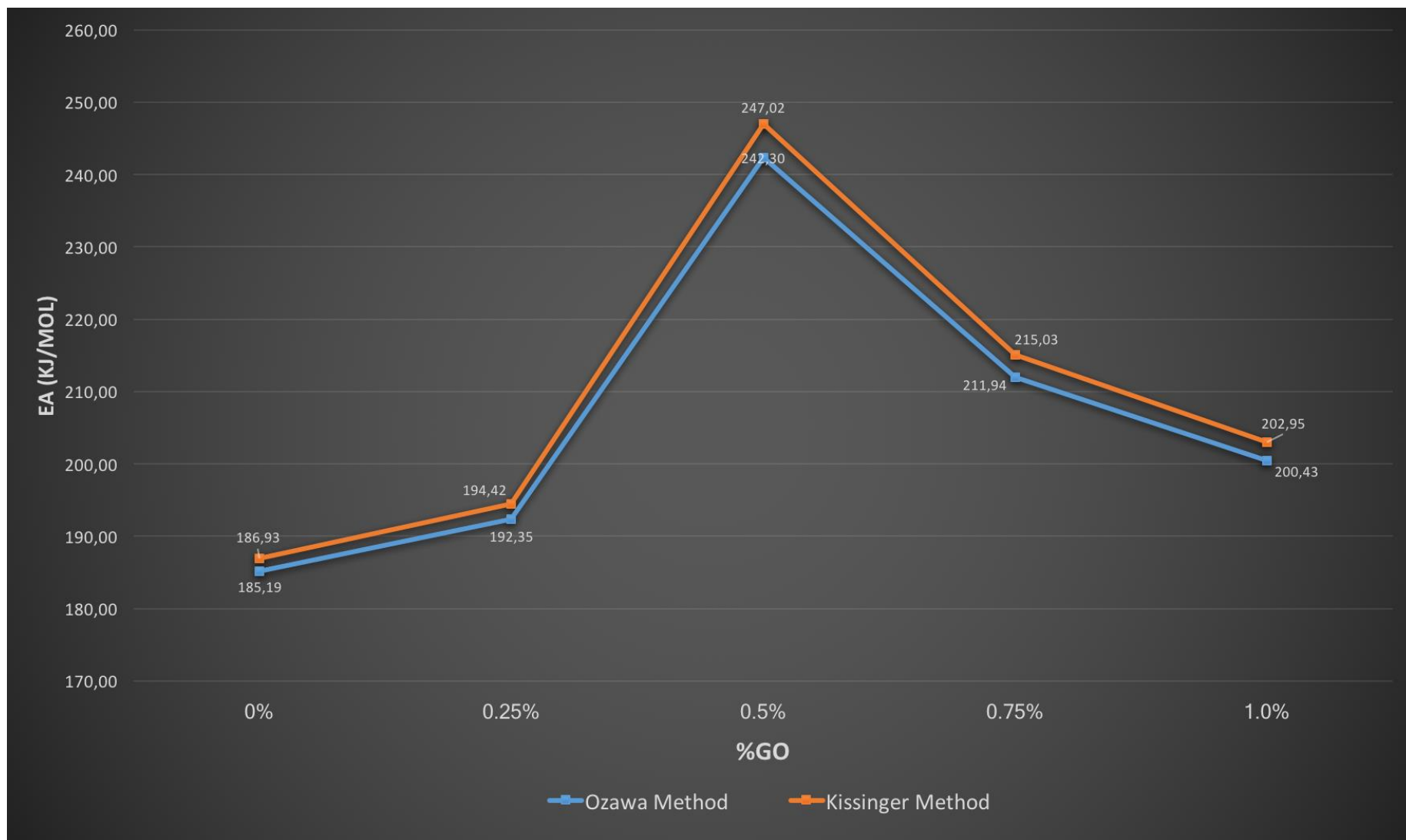
Result

NC/DEGDN Decomposition as a Function of GO



Result

Comparison of Activation Energy with and without GO





Conclusion

1. Raman spectra analysis: Graphene oxide shows some interaction with NC/DEGDN by the formation of the hydrogen bonds within NC/DEGDN matrix.
2. NC/DEGDN compositions with GO are thermally more stable than that of the compositions without GO.
3. The activation energy of decomposition of nitrate ester groups in NC/DEGDN increases significantly with GO and reaches to a maximum point with 0.5% GO loading and then starts decreasing.



Thank you for your time

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