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CO2 participation in cross-linking reactions and char formation during bio-oil pyrolysis

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CO_2 PARTICIPATION IN CROSS-LINKING REACTIONS AND CHAR FORMATION DURING BIO-OIL PYROLYSIS.

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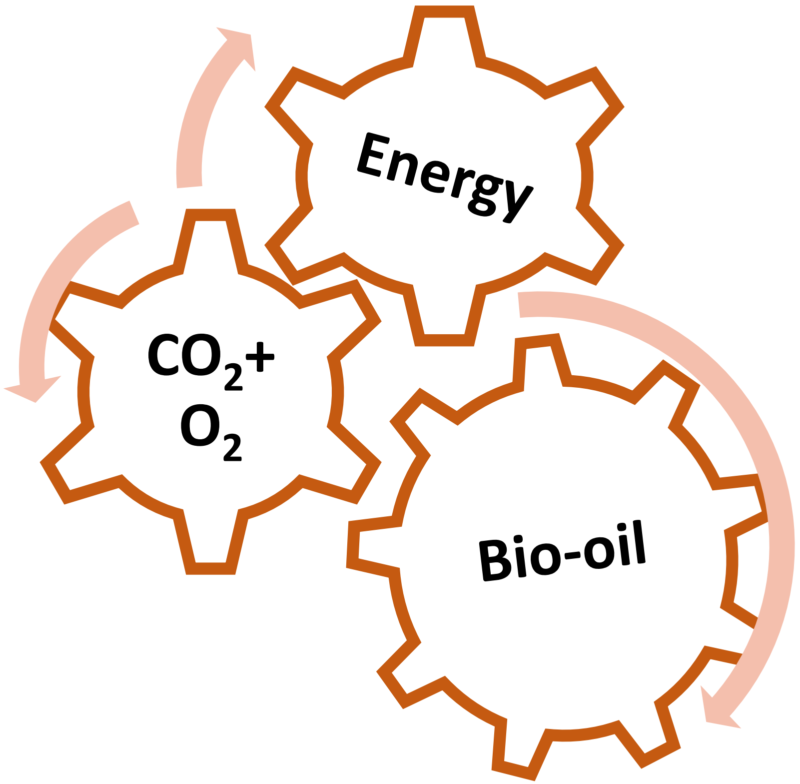
Outline

- ➢ **Introduction**
- ➢ **Methodology**
- ➢ **Results**
- ➢ **Final remarks**

Introduction

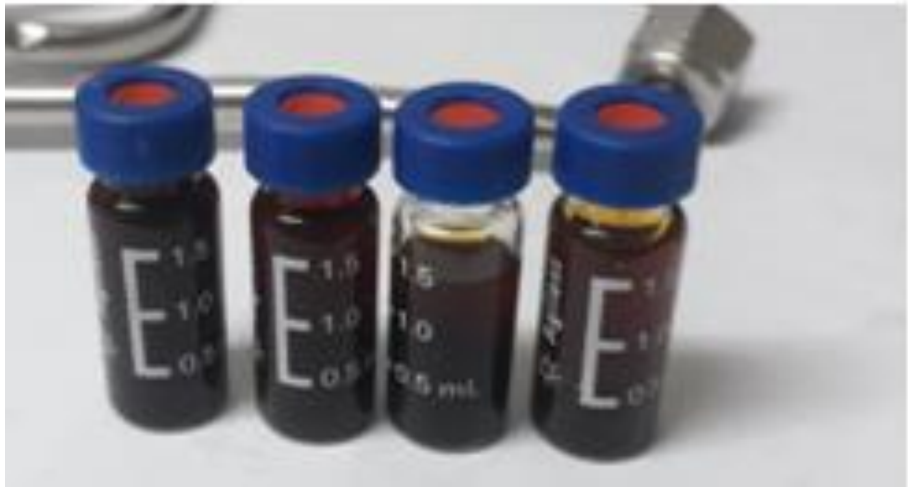
The integration of oxy-fuel technologies with new fuels such as biomass-derived pyrolysis oil facilitates CO_2 capture and storage with reduced pollution emissions and renewable approach.

- The thermal decomposition of bio-oil under the atmosphere of N_2 and CO_2 presents significant differences.
- Chemical reactivity of CO_2 plays an important role in the pyrolysis.

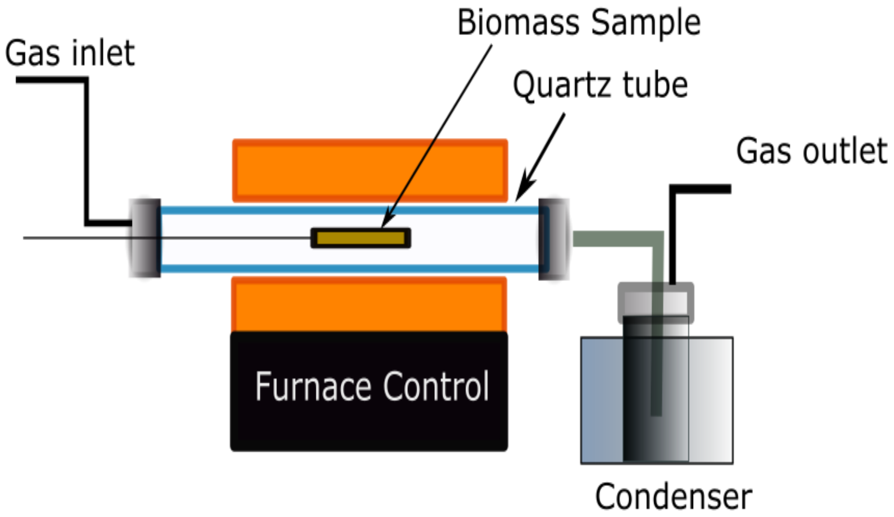


Methodology

- **Bio-oil fabrication** (Pyrolysis under N_2 atmosphere 50 mL/min, 550 °C at lab scale).



Sugarcane Bagasse



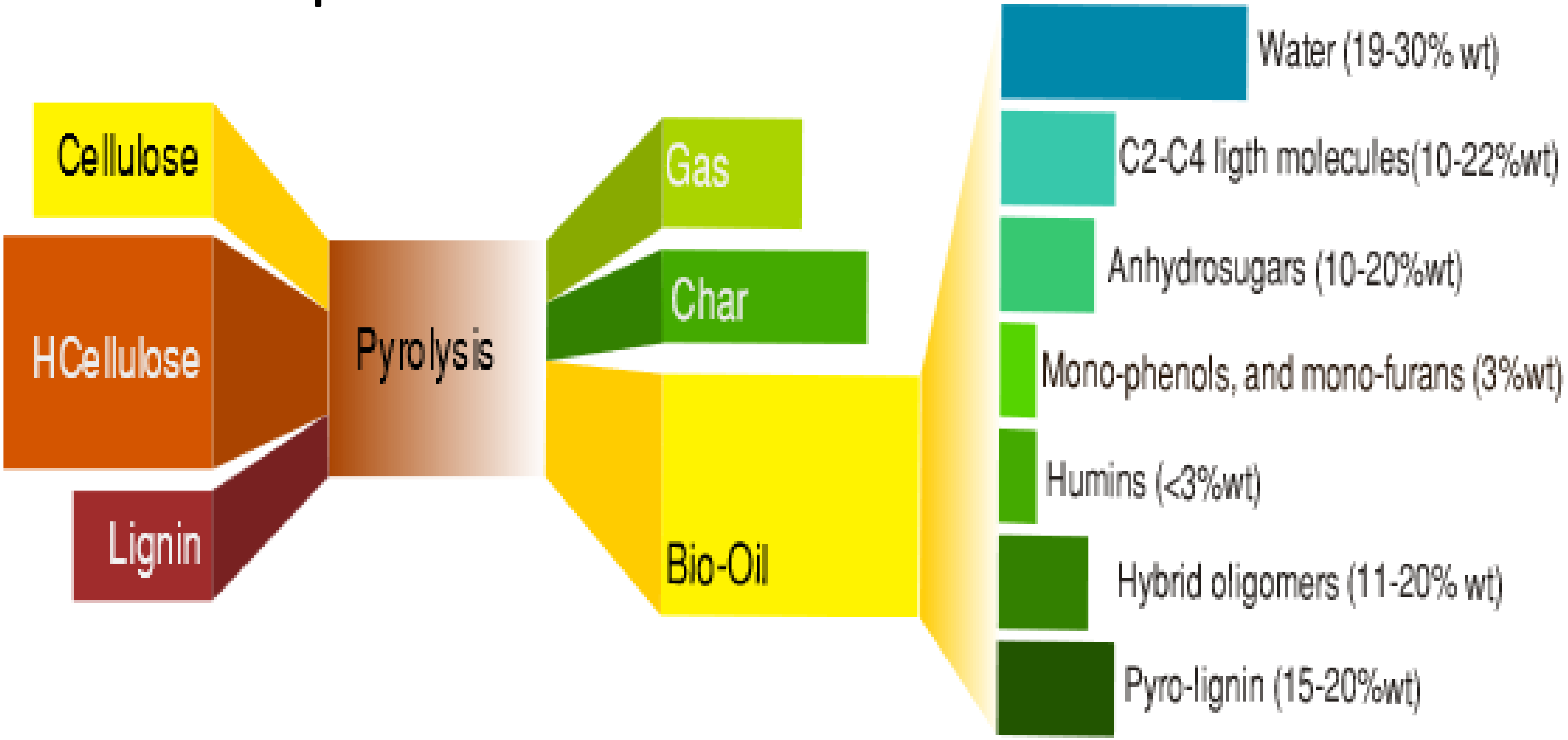
- **Bio-oil Characterization**.
  - ✓Elementary analysis,
  - ✓GC-MS, ESI-FT-ICR,
  - ✓H-NMR and C-NMR,
  - ✓TG Analysis (N_2 and CO_2).

Methodology

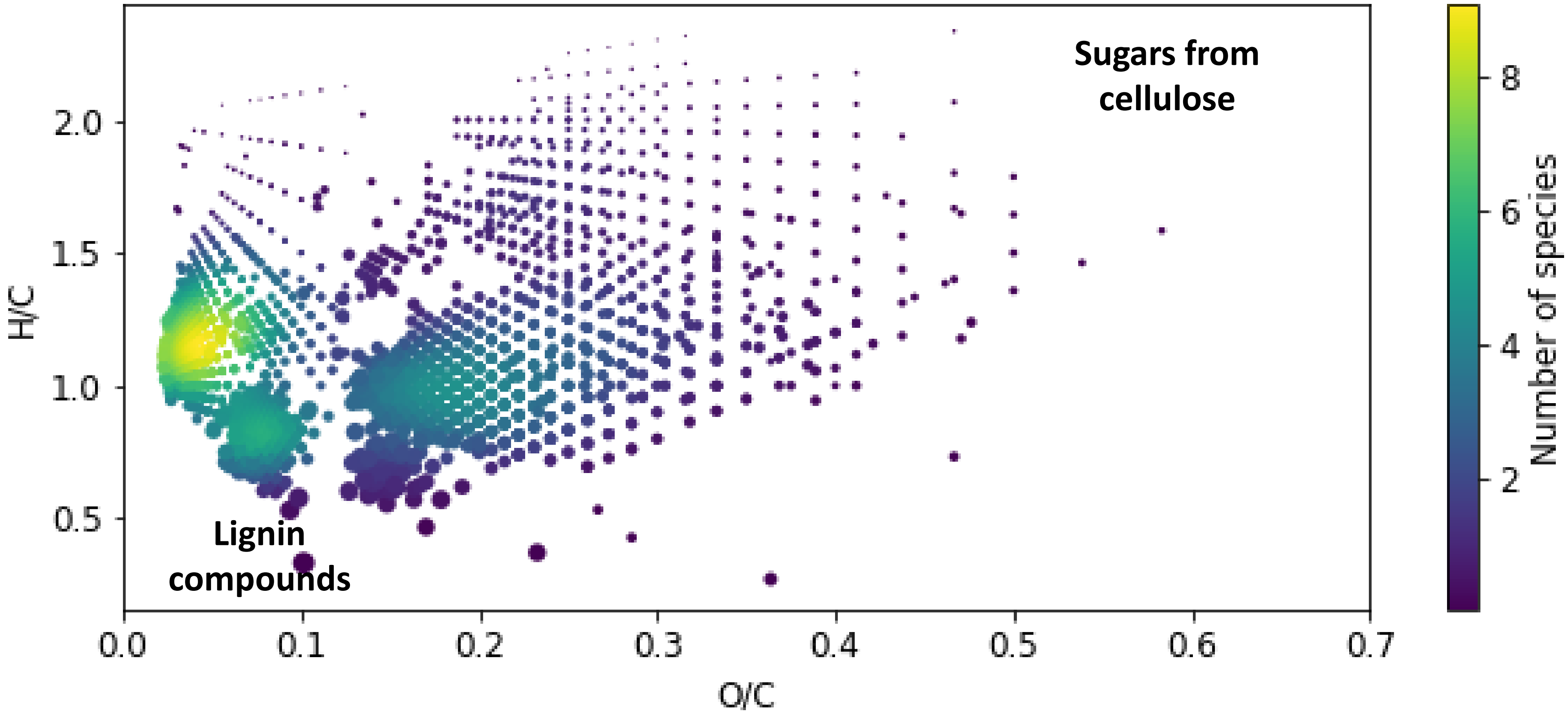
Char Characterization. Char samples were obtained before (400 °C) and after (700 °C) of the cross-linking reactions and their chemical characteristics were analyzed by using FTIR, Reactivity Analysis and Elementary Analysis, which permitted to elucidate the role of CO_2 in the carbonization.

Results

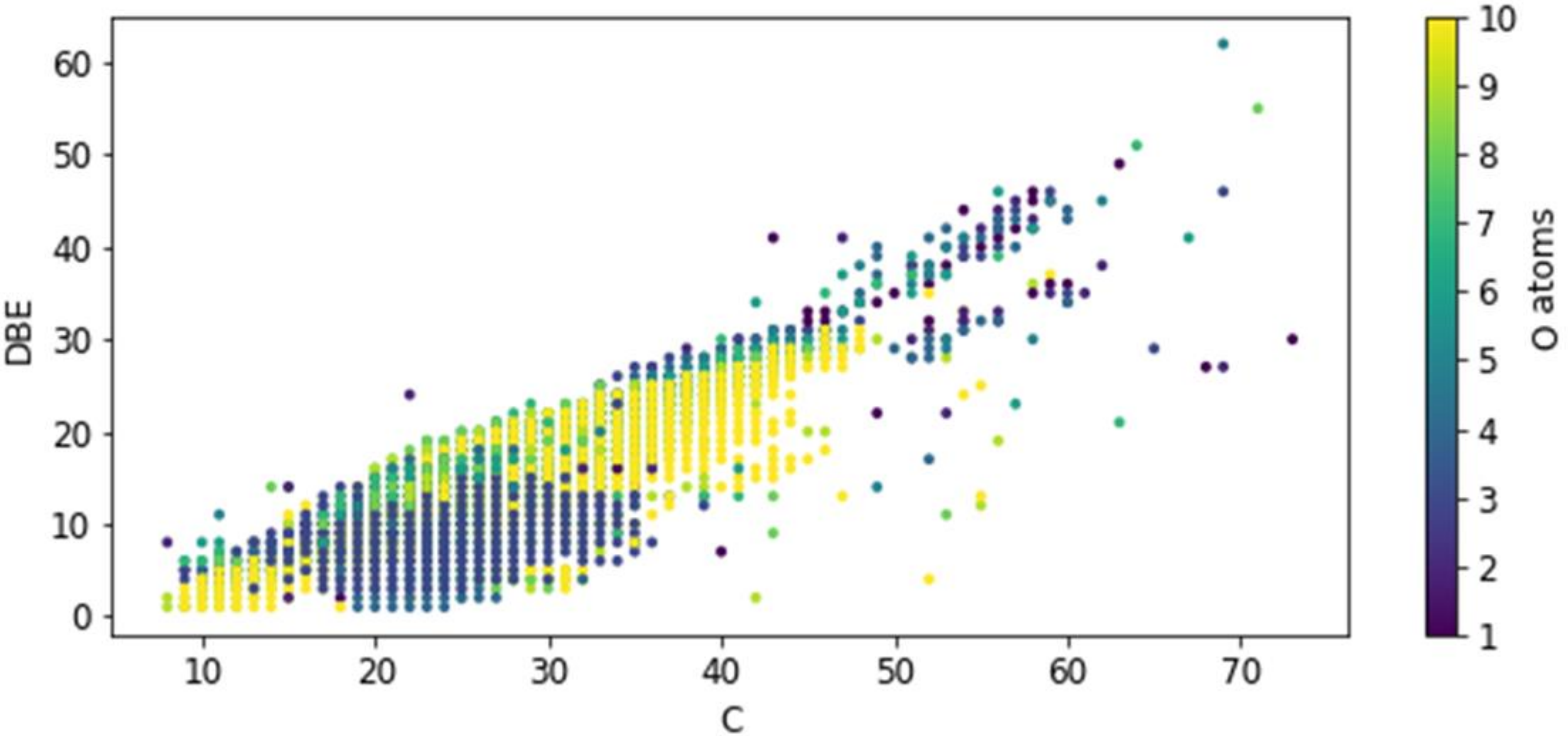
Bio-oil Composition



Results (ESI(-) FT ICR) Biooil Characterization (heavy compounds).

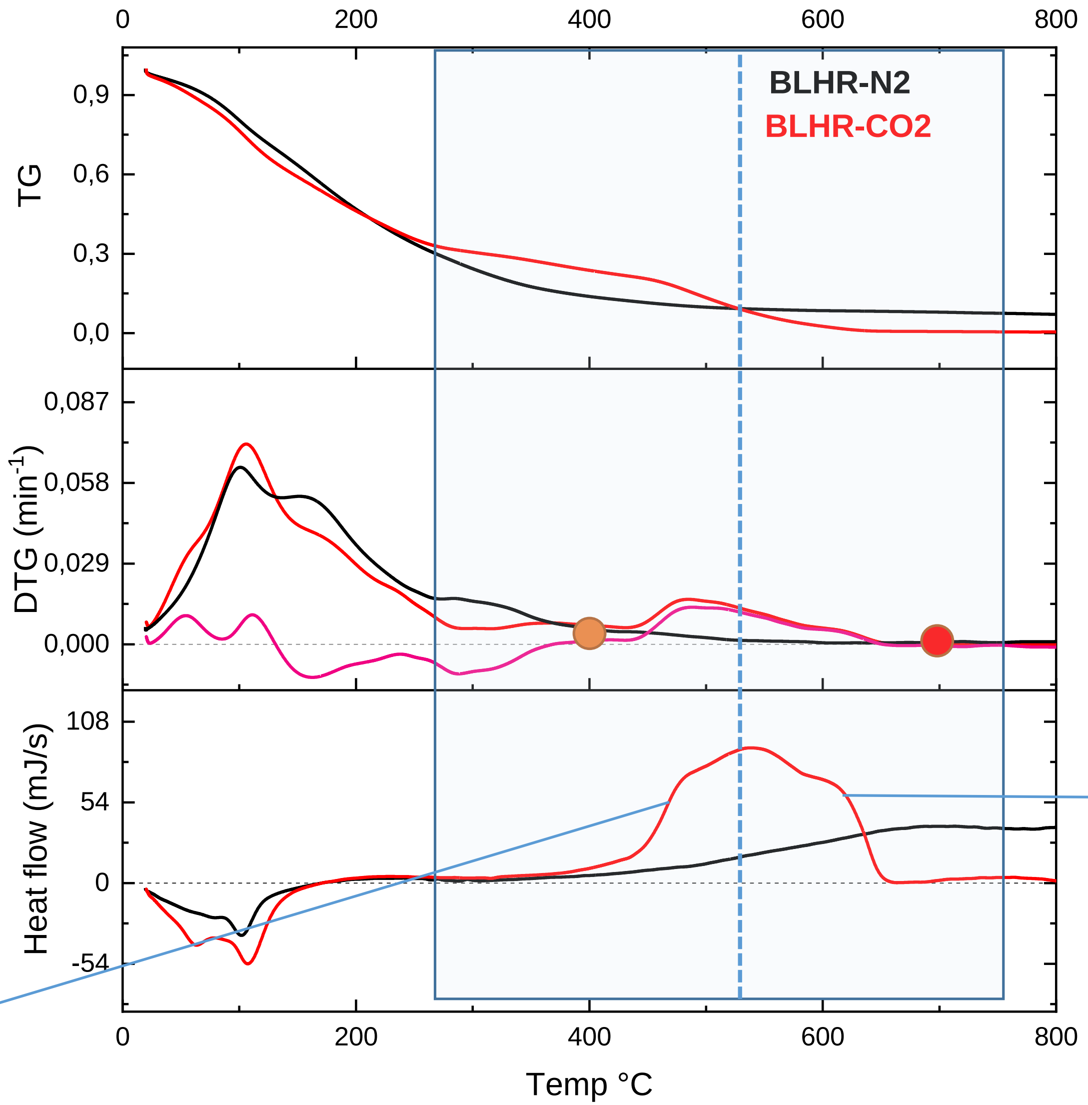


Results (ESI(-) FT ICR)



Results (TG-DTG and heat flow of bio-oil in N_2 and CO_2 atmosphere)

CO_2 effect



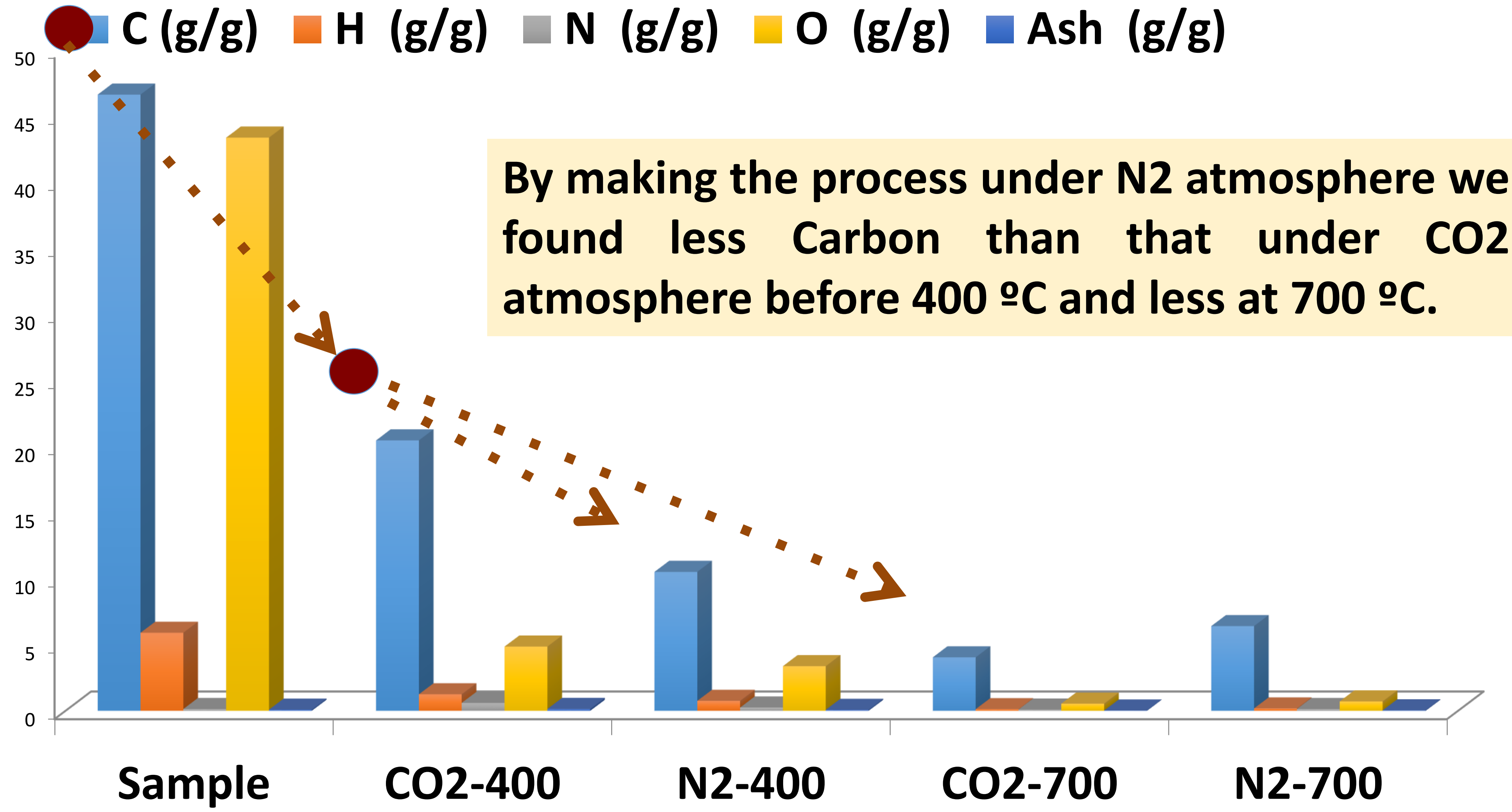
At temperatures between 300°C and 700°C the CO_2 modifies the dynamics of thermal degradation

Char samples at 400°C and 700°C

Energy realized due to de-polymerization and reorganization reactions

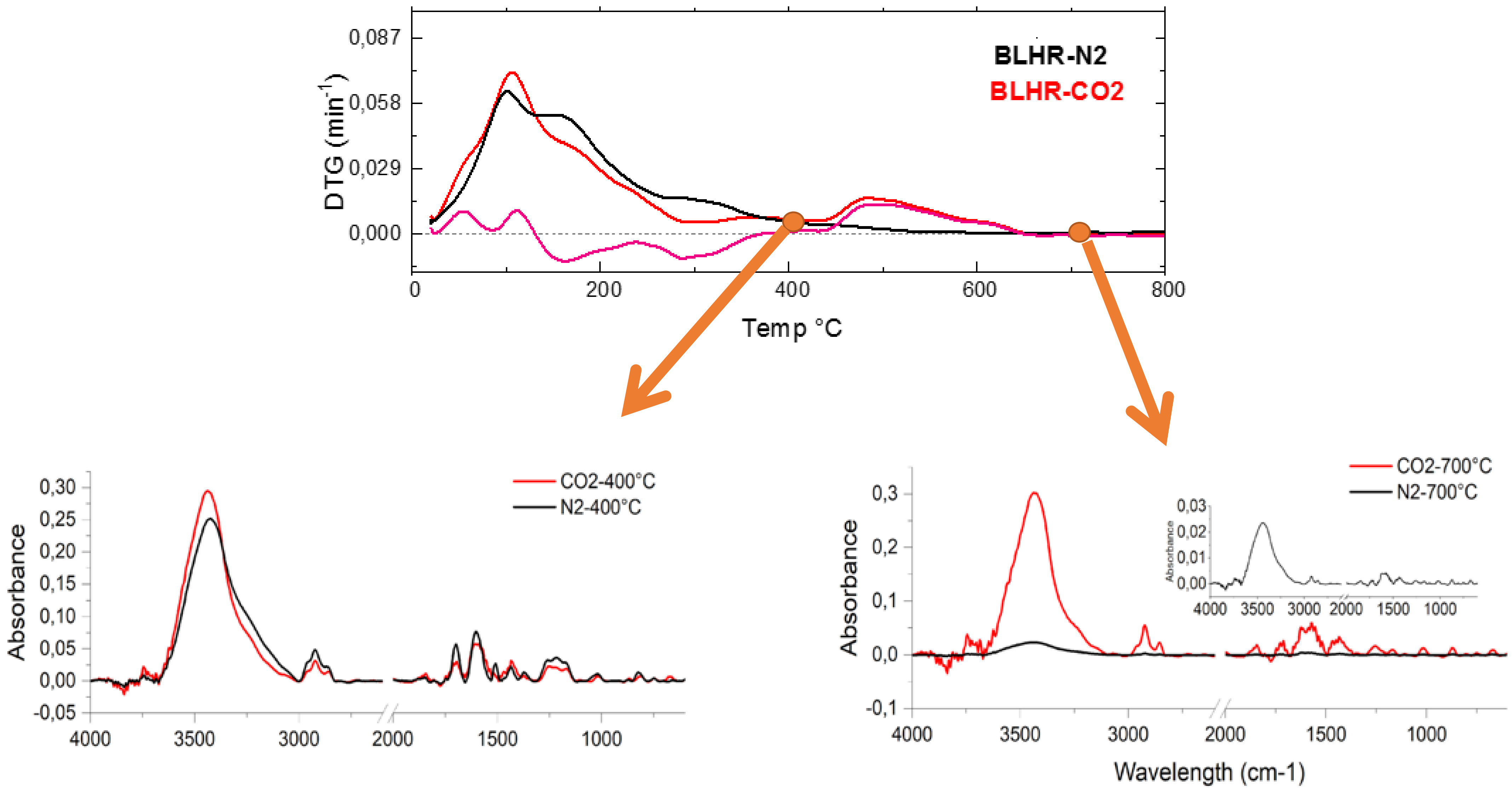
Energy decreases due to possible gasification process

Results (Char Elemental analysis)

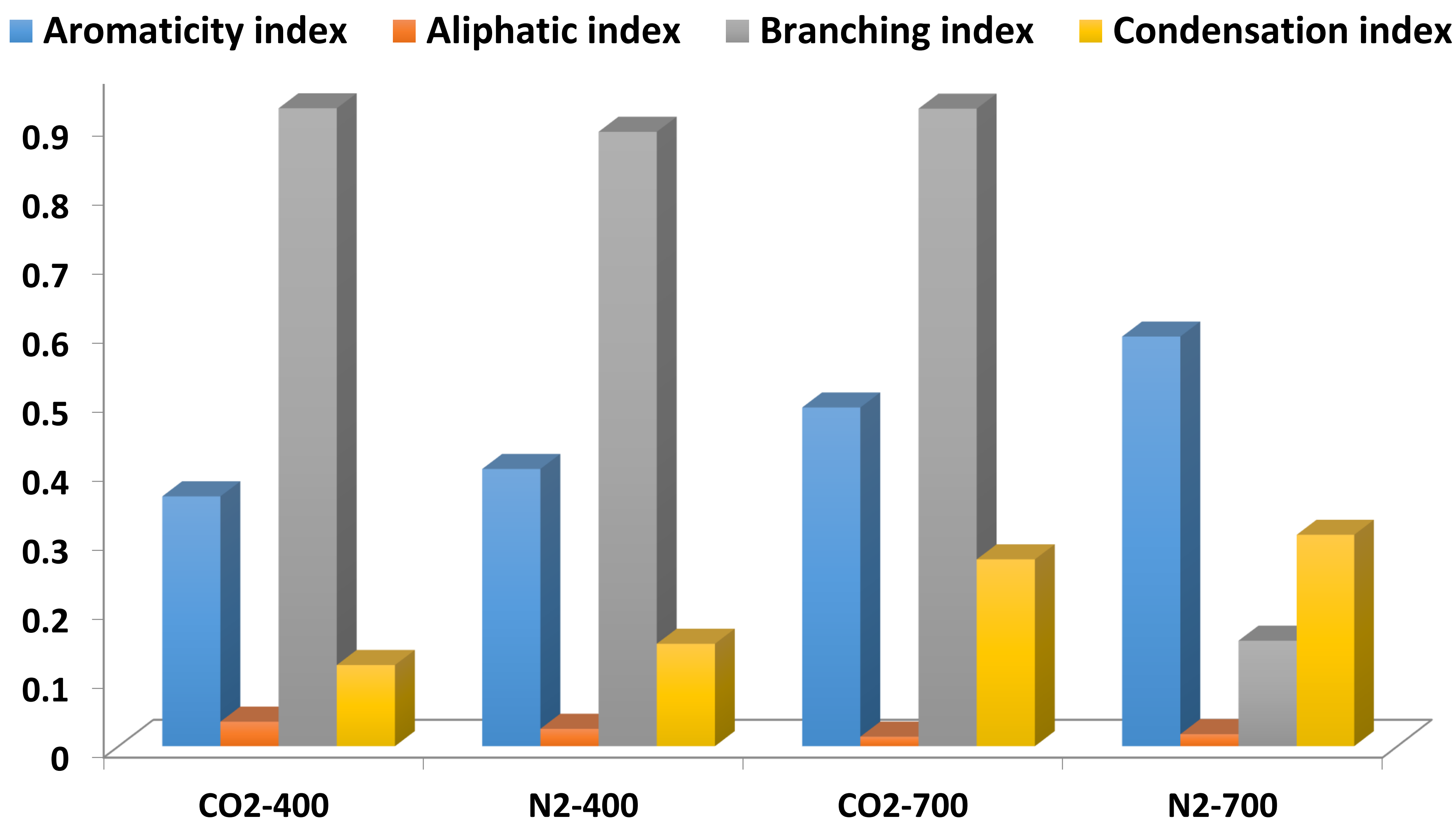


By making the process under N2 atmosphere we found less Carbon than that under CO2 atmosphere before 400 ºC and less at 700 ºC.

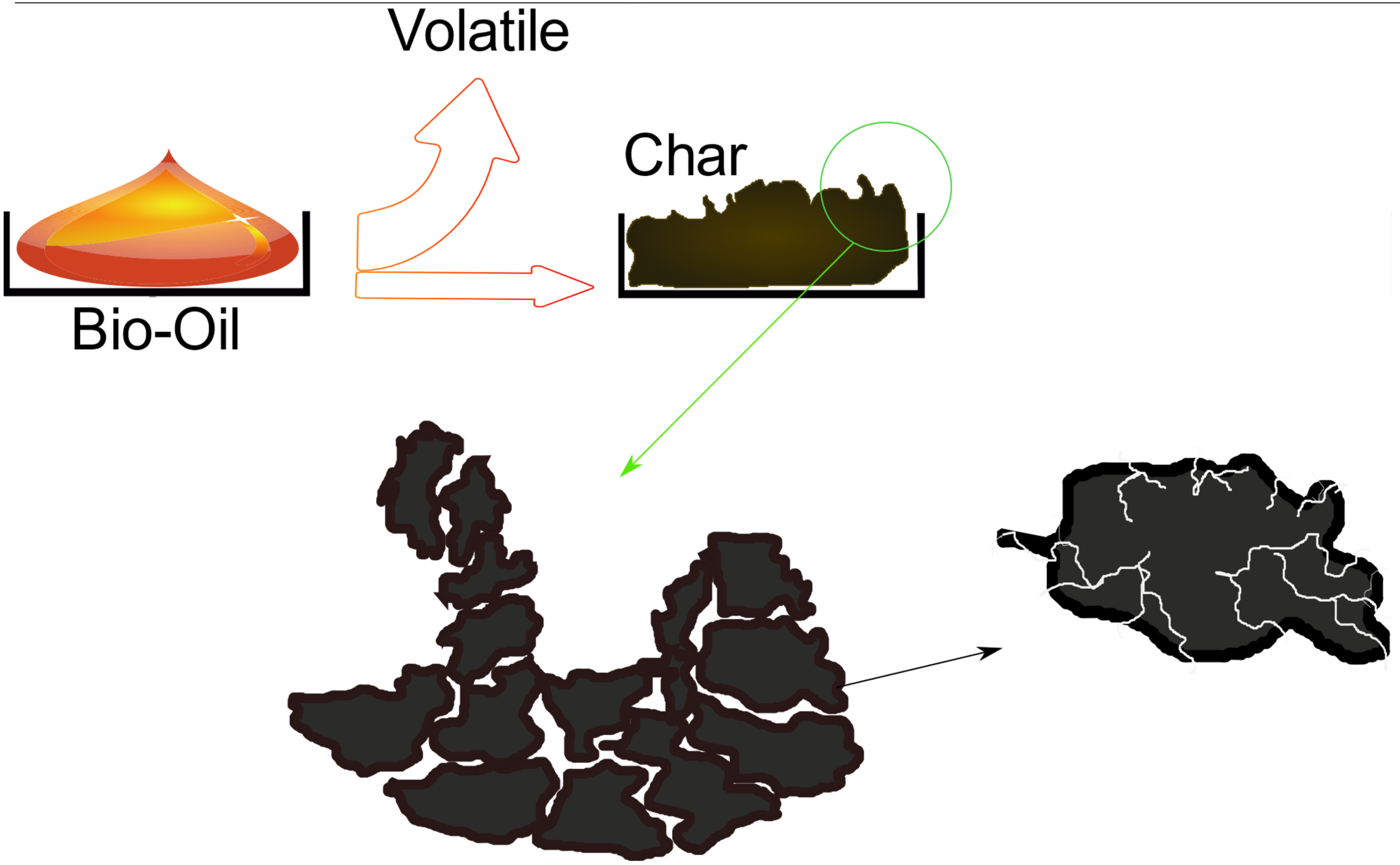
Results (Char FTIR)



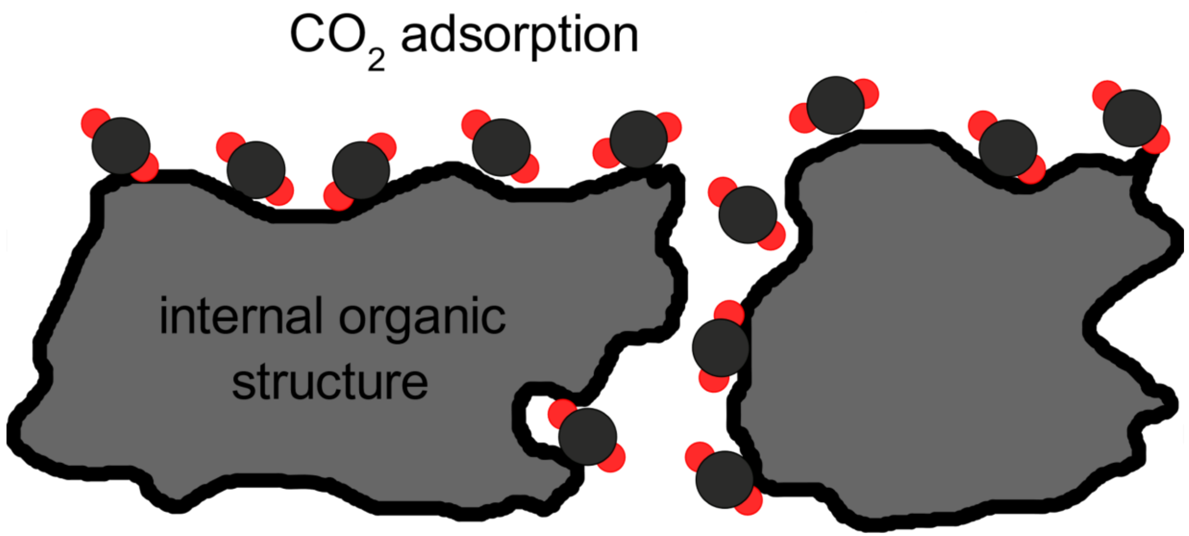
Results (Char FTIR-analysis)



Final remarks



Final remarks



300°C

- **CO_2 Chemisorbed due to Interaction with oxygenated compounds**

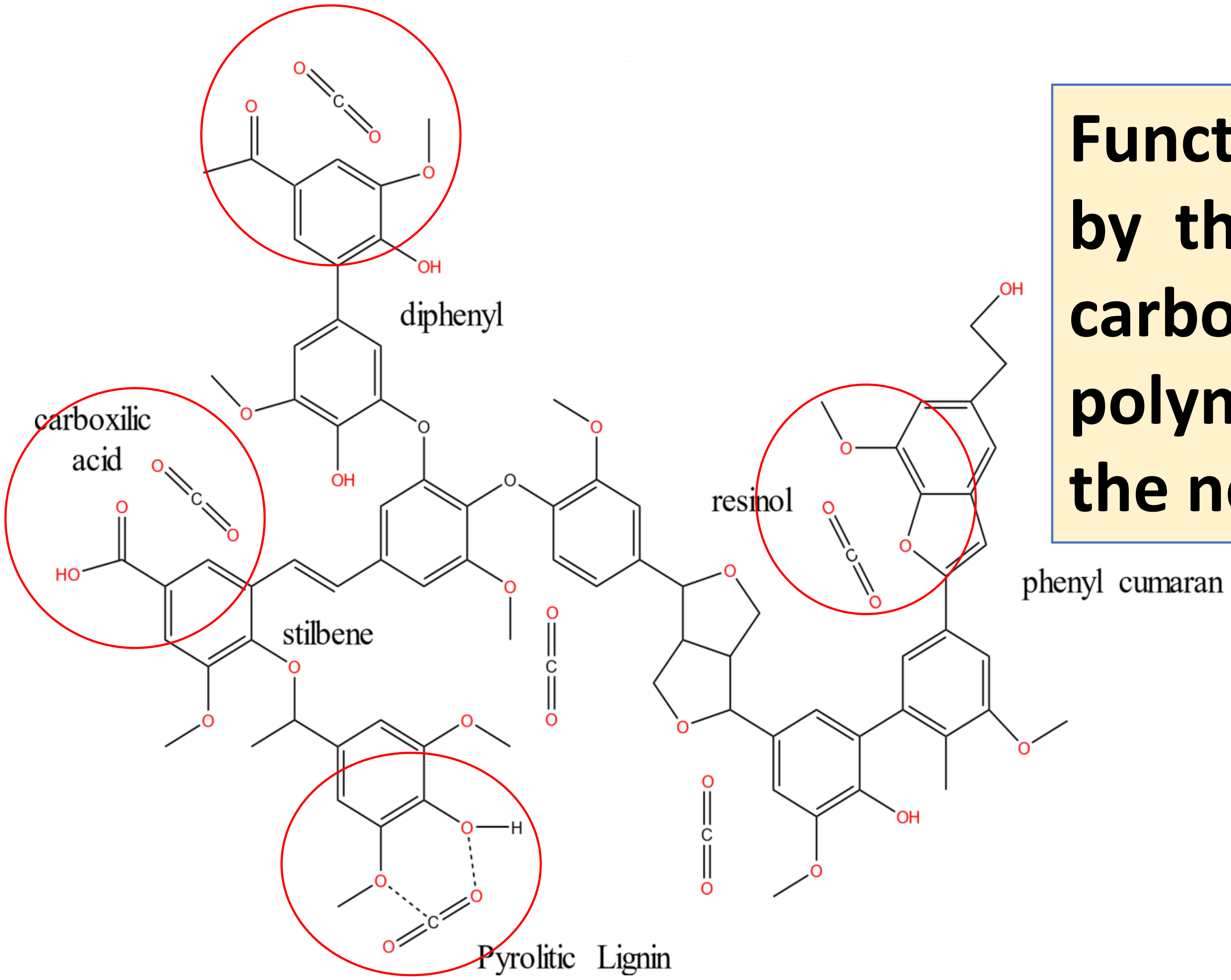
400-500 °C

- **Molecular reorganization of organic internal structure (Cross-Linking or de-polymerization).**

500-700°C

- **Thermal degradation of char formed, e.g., gasification**

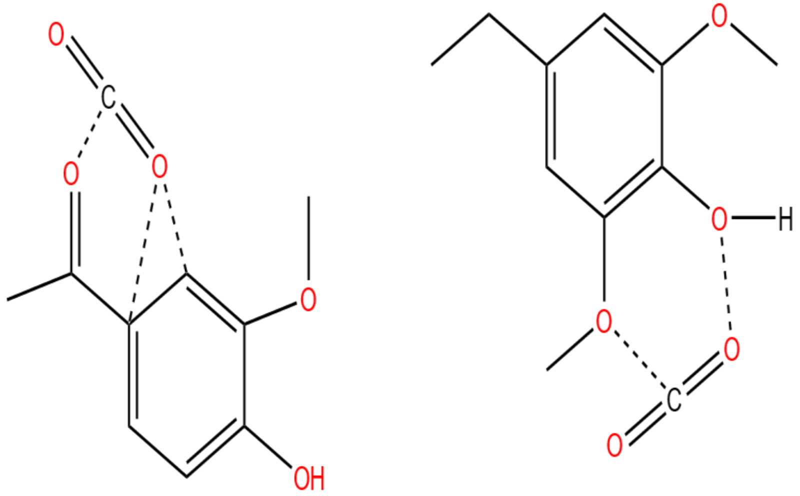
Final remarks



Functional groups are stabilized by the CO_2 adsorbed, and the carbonization reactions or de-polymerization are carried out in the non-superficial structure.

Final remarks

C-H···O Hydrogen Bonding in CO2-Lewis Base



Under CO_2, the oxygenated outer groups of pyrolygnine are stabilized by hydrogen bonds and the carbonization takes place between benzene rings.

This explains why the number of paraffinic carbons is maintained after carbonization and remaining oxygen is higher than that under N_2 atmosphere.

Final remarks

It was found that the destruction of functional groups corresponding to the oligomers of lignin present in the bio-oil is strongly influenced when the process is carried out under N_2 atmosphere, **whereas under CO_2 atmospheres the functional groups remained within the char after carbonization process.**

Due to

The outgoing water generated during the hydrolysis processes are restricted by CO_2 presence.

Final remarks

Carbon dioxide influences the degradation of products derived from lignocelluloses structures. Furthermore, it can be used in the improvement of technological processes such as the pre-oxidation of bio-oil, production of high reactivity bio-char, production of high value-materials and supercritical extraction.

Acknowledgments

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Thanks

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