Preparation of graphitic carbon by catalyst-free pyrolysis of Lignin to reduce volatile organic compound of the work environment

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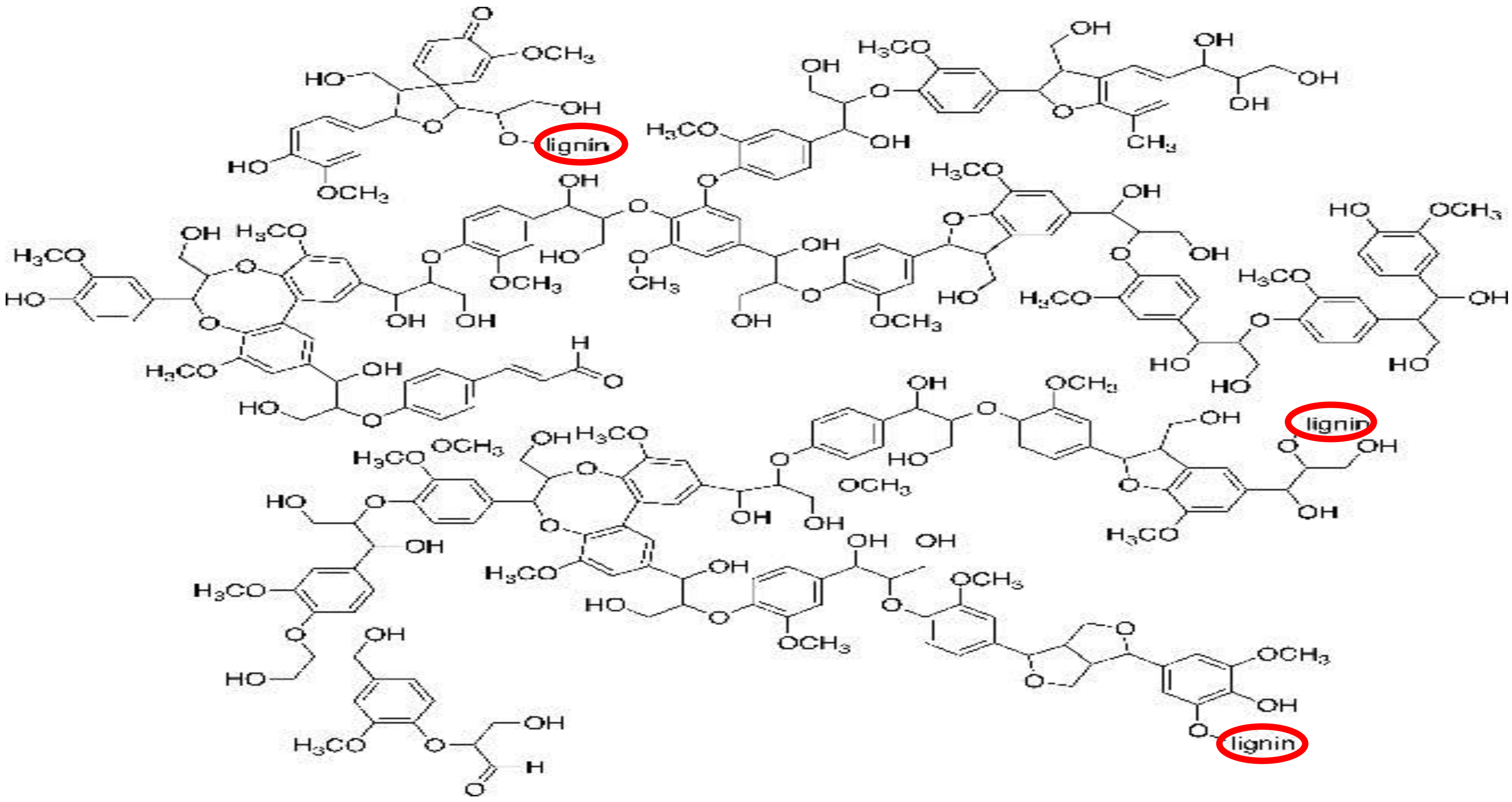
Summary

- Abstract;
- Lignin;
- Scannig Electron Microscopy (SEM/FEG);
- Fourier Transform Infrared Spectroscopy (FTIR);
- Raman Spectroscopy;
- X-ray diffraction;
- Conclusion.

Abstract

In the last decades the chemical industry has intensified its efforts to reduce, prevent and eliminate the environmental impacts it has caused. At the same time, there is a growing concern for human well-being. Monitoring the work environment is increasingly common, thus ensuring the safety and health of the worker. Emissions of volatile organic compounds have motivated several research activities to develop efficient and low cost technologies for their capture. The preparation of a carbonaceous material from lignin, the second most abundant biopolymer in the nature and sub product of the paper industry, appears as an alternative to this demand. Mesoporous graphitic materials can be obtained from lignin pyrolysis at 800 °C and deposited in polymer matrices or quartz plates for the physical adsorption of these harmful substances.

Lignin



Scanning Electron Microscopy - FEG

Lignin as received:

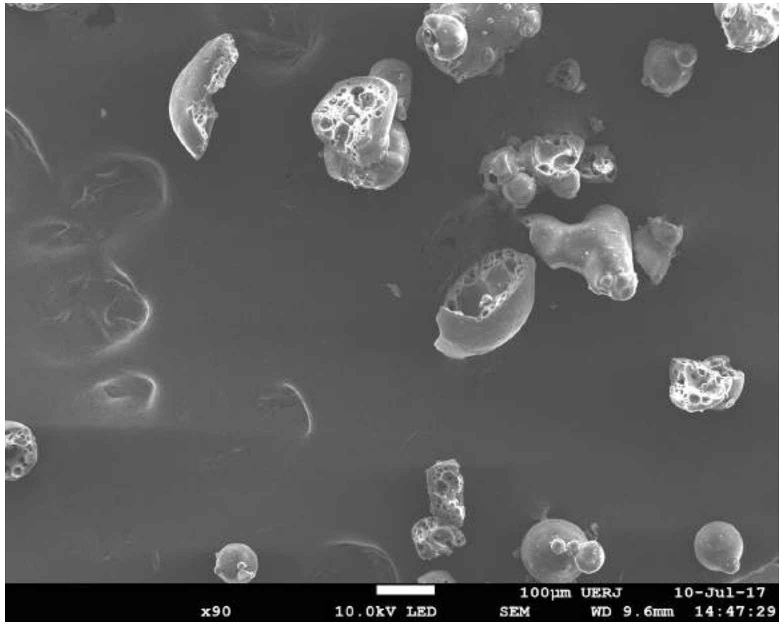


Figure 1

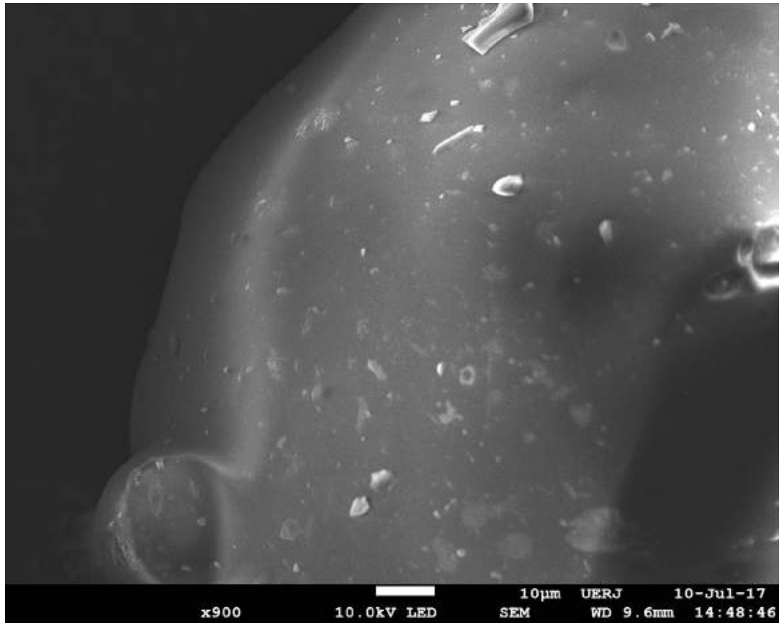


Figure 2

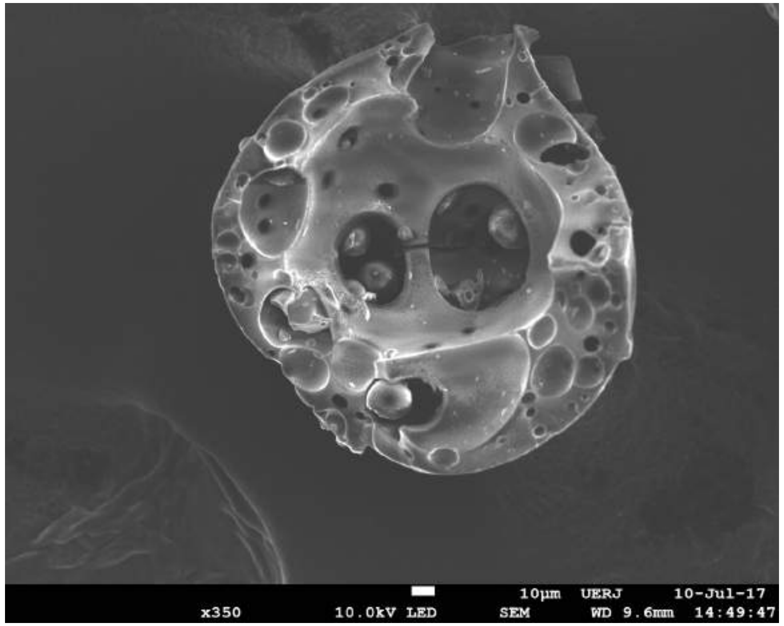
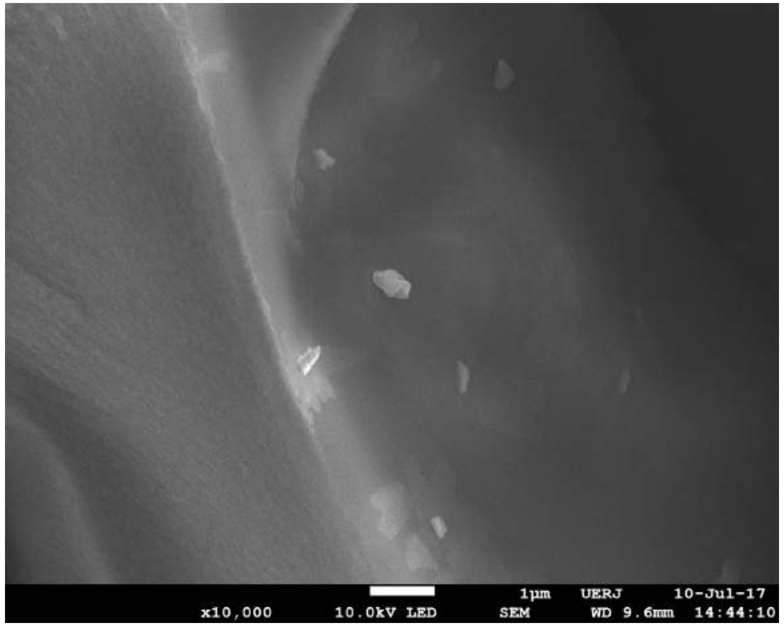


Figure 3

Scanning Electron Microscopy - FEG

Lignin as received:



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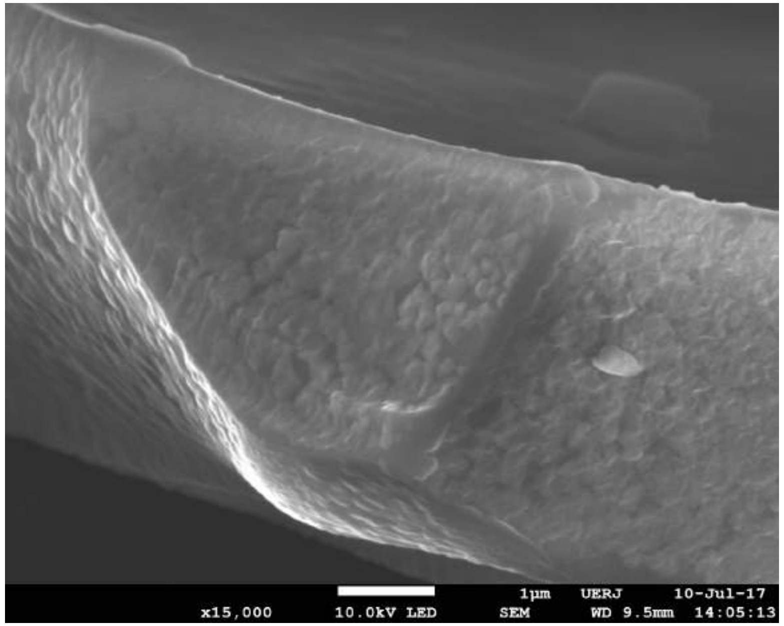


Figure 5

Figures 1,2,3,4 ,5: SEM images showing shapes, forms and surface of Lignin as received.

Scanning Electron Microscopy - FEG

Lignin pyrolyzed at 200°C

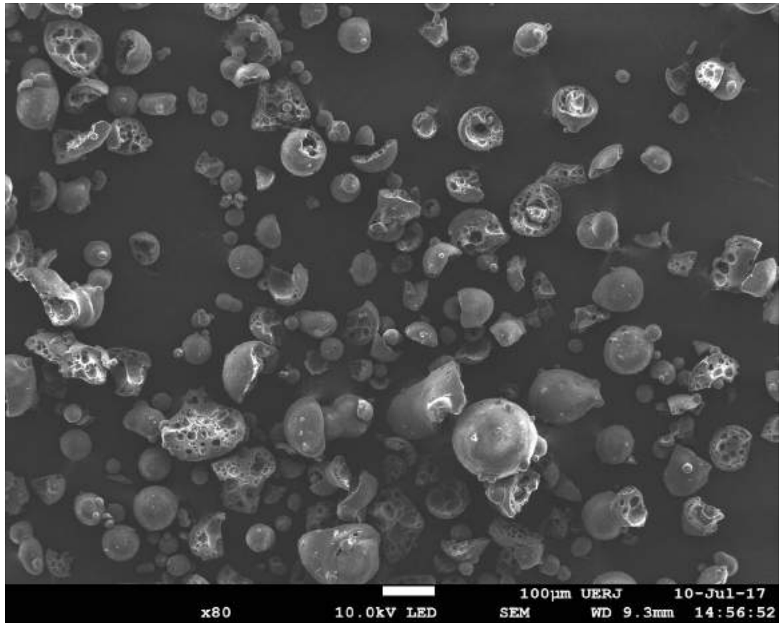
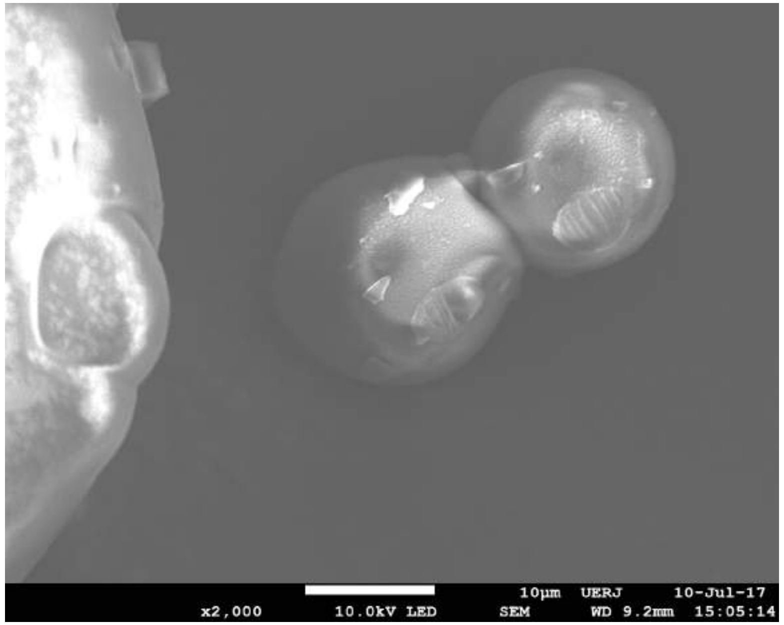


Figure 6



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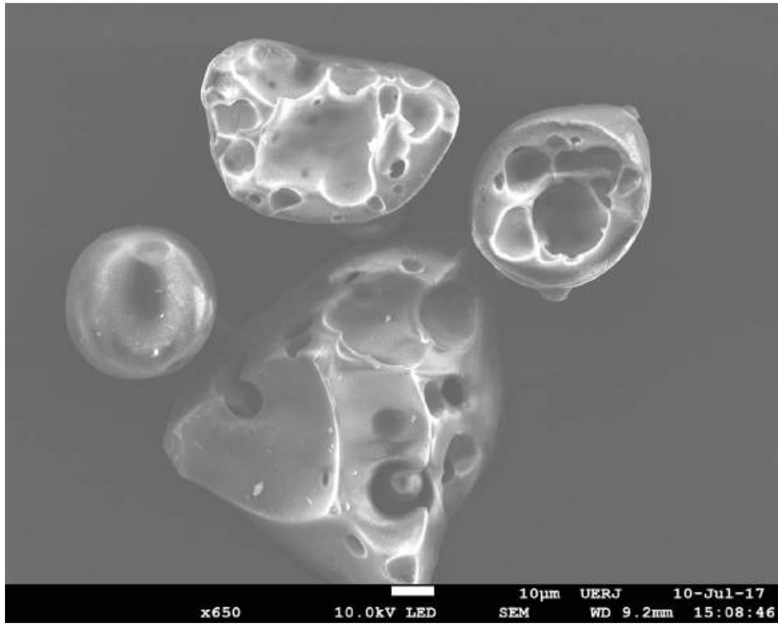


Figure 8

Figures 6,7,8 : SEM images showing shapes, forms and surface of Lignin pyrolyzed at 200°C.

Scanning Electron Microscopy - FEG

Lignin pyrolyzed at 400°C

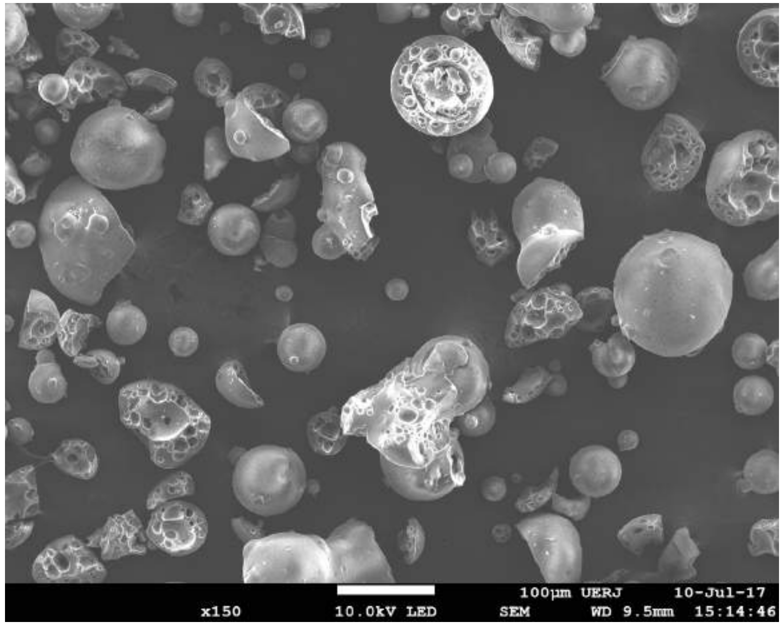


Figure 9

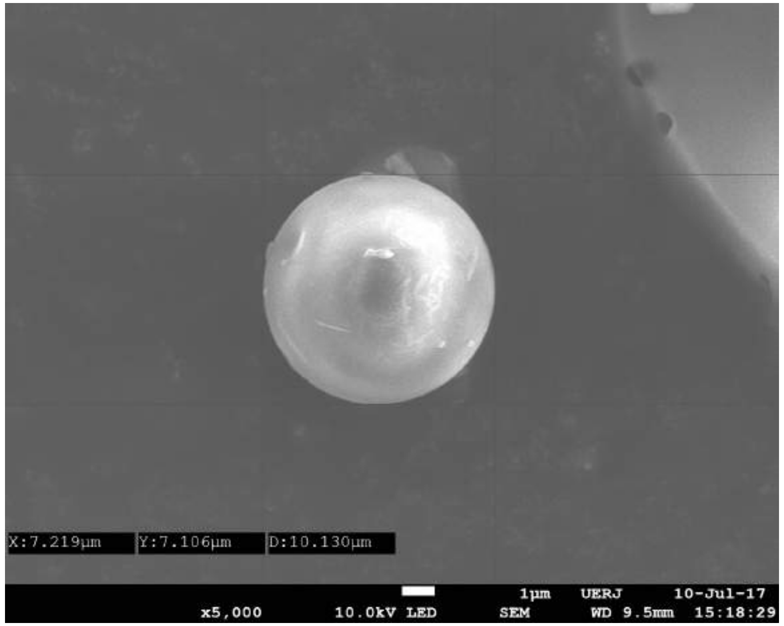


Figure 10

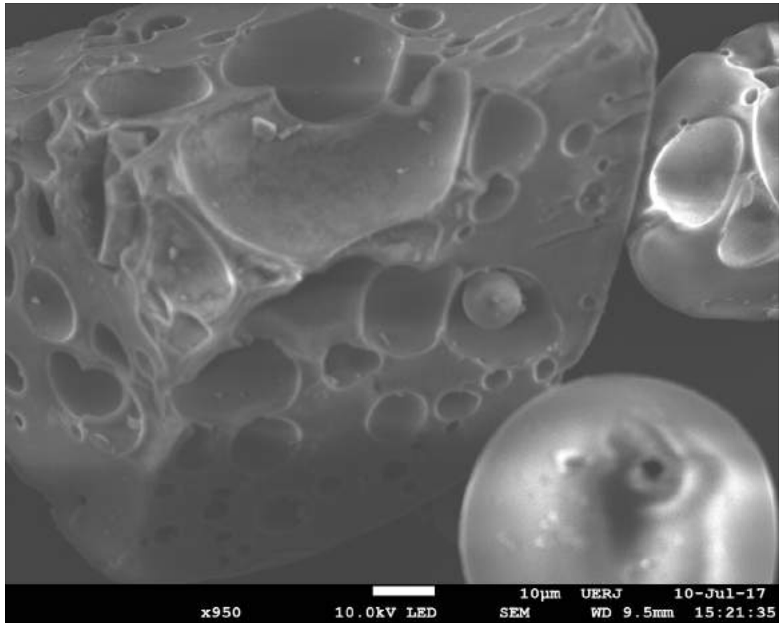


Figure 11

Figures 9,10,11 : SEM images showing shapes, forms and surface of Lignin pyrolyzed at 400°C.

Scanning Electron Microscopy - FEG

Lignin pyrolyzed at 600°C

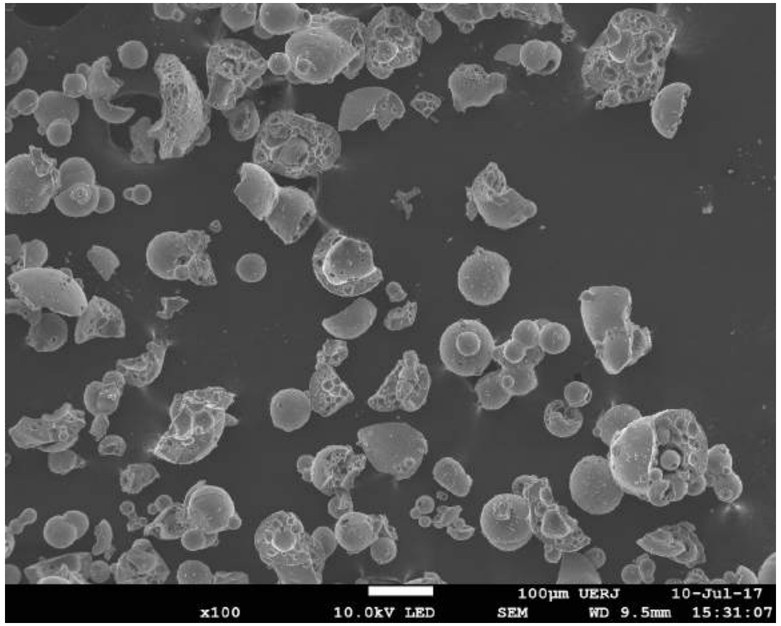
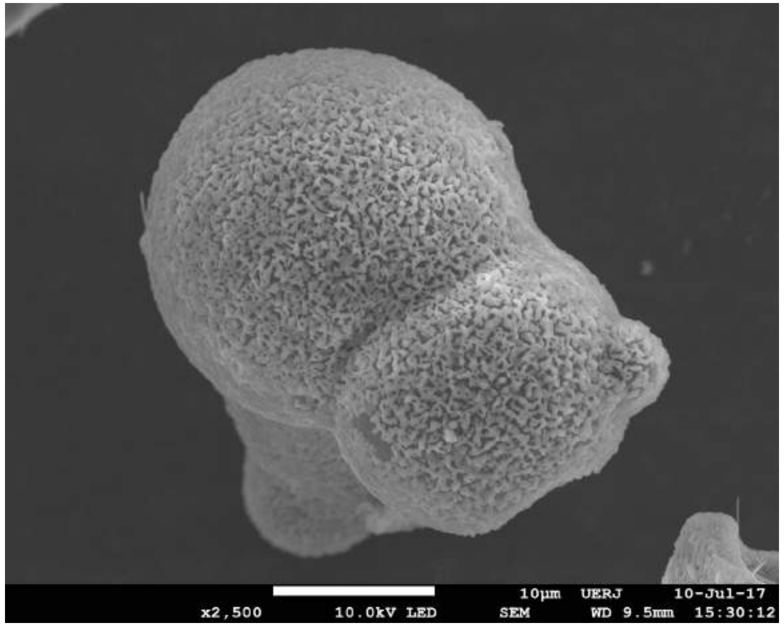


Figure 12



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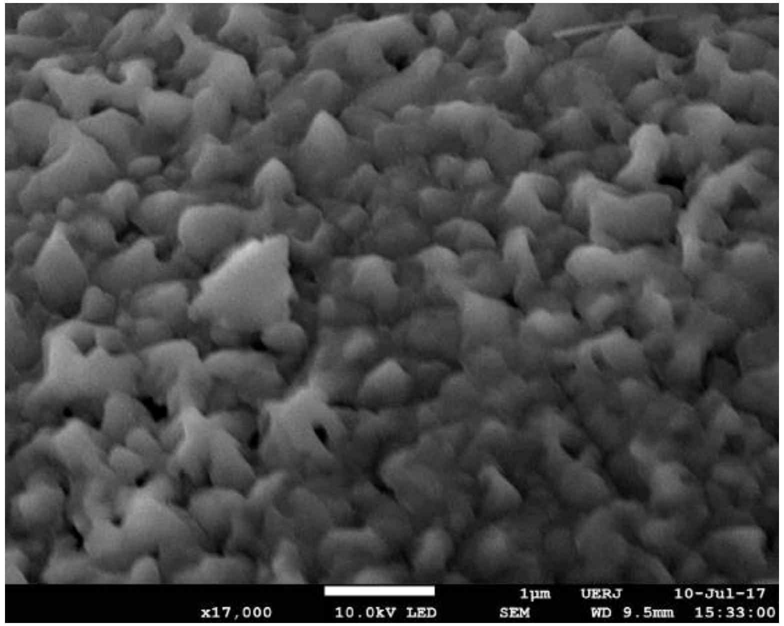


Figure 14

Figures 12,13,14 : SEM images showing shapes, forms and surface of Lignin pyrolyzed at 600°C.

Scanning Electron Microscopy - EDS

Lignin pyrolyzed at 800°C

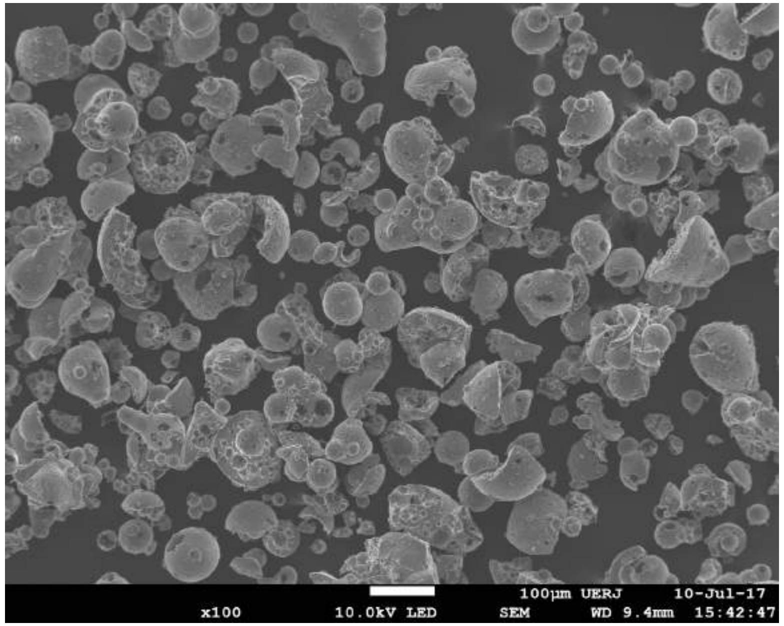


Figure 15

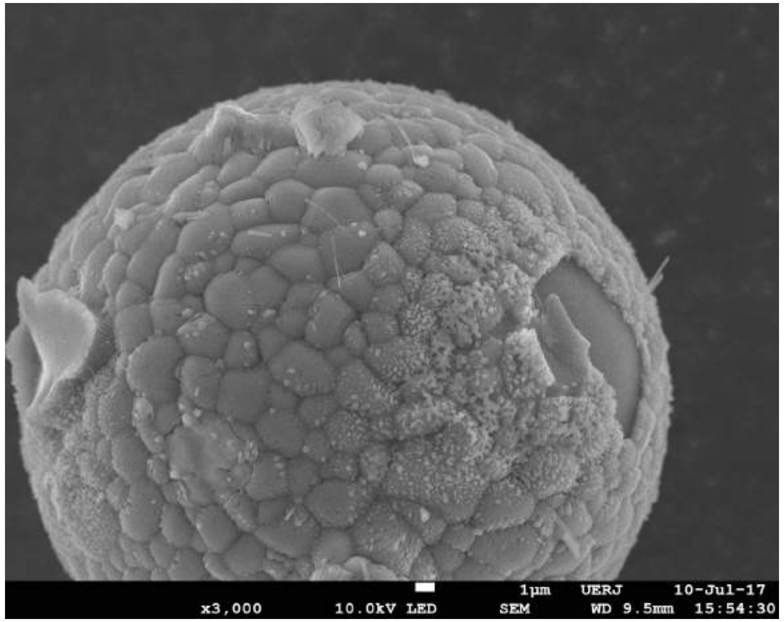


Figure 16

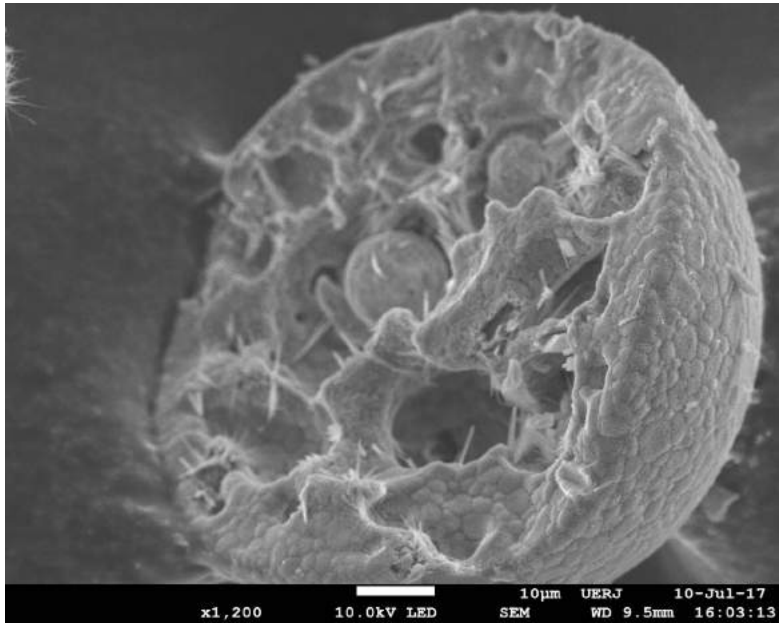


Figure 17

Figures 15,16,17: SEM images showing shapes, forms and surface of Lignin pyrolyzed at 800°C.

Fourier Transform Infrared Spectroscopy (FTIR)

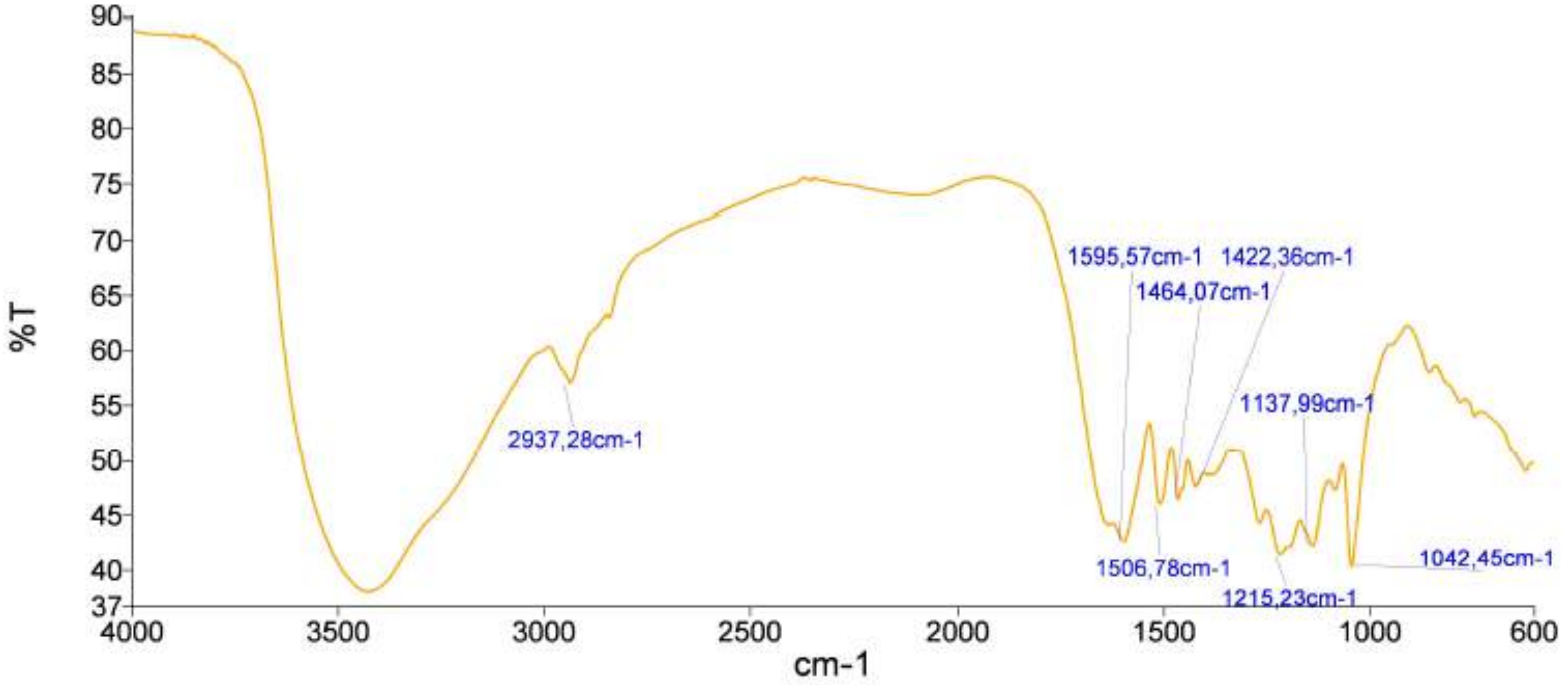


Figure 18: FTIR spectra of commercial Lignin as received.

Fourier Transform Infrared Spectroscopy (FTIR)

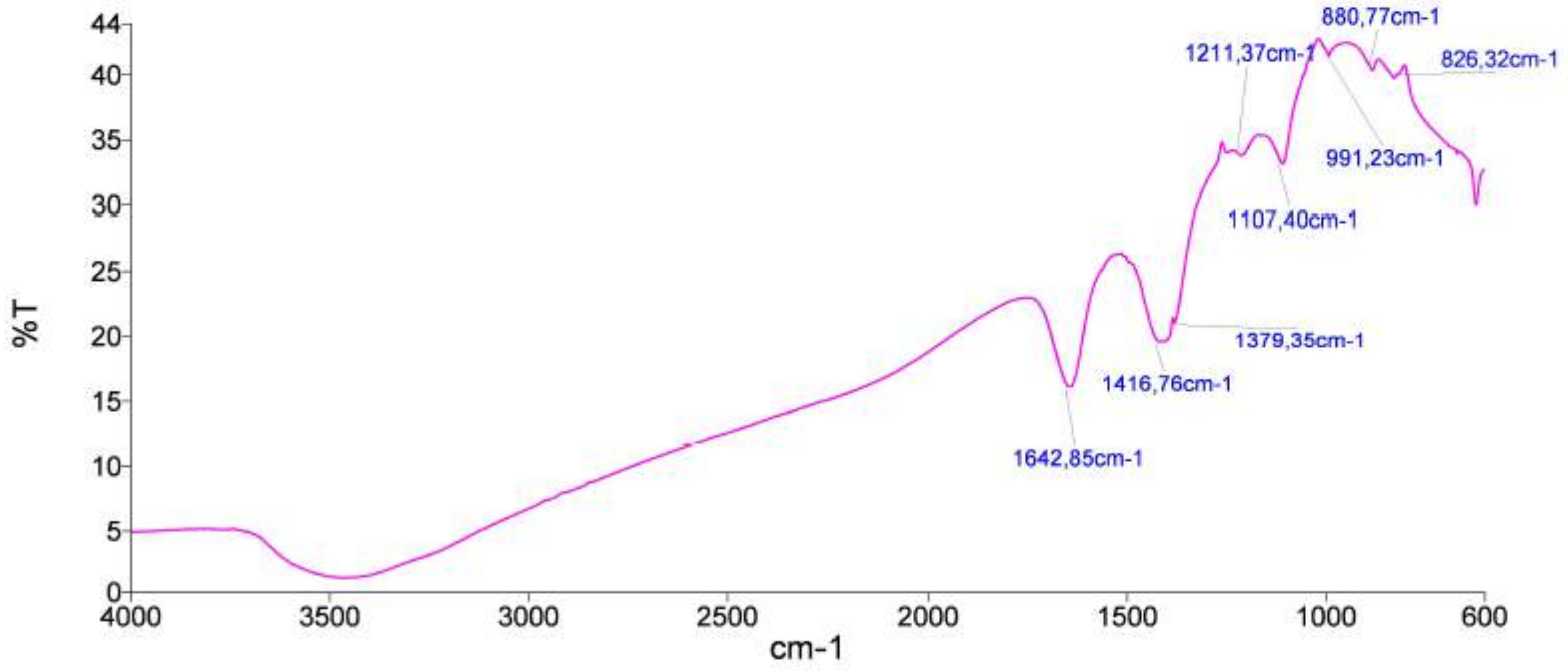
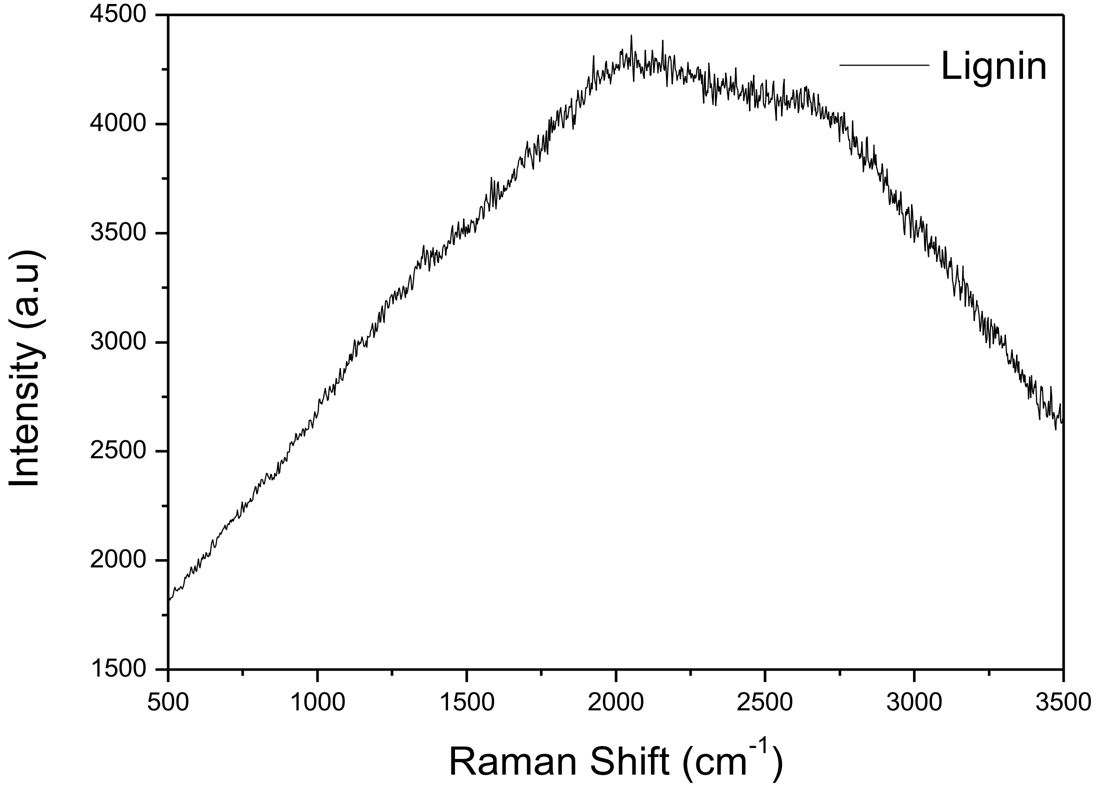


Figure 19: FTIR spectra of commercial Lignin as received.

Raman Spectroscopy



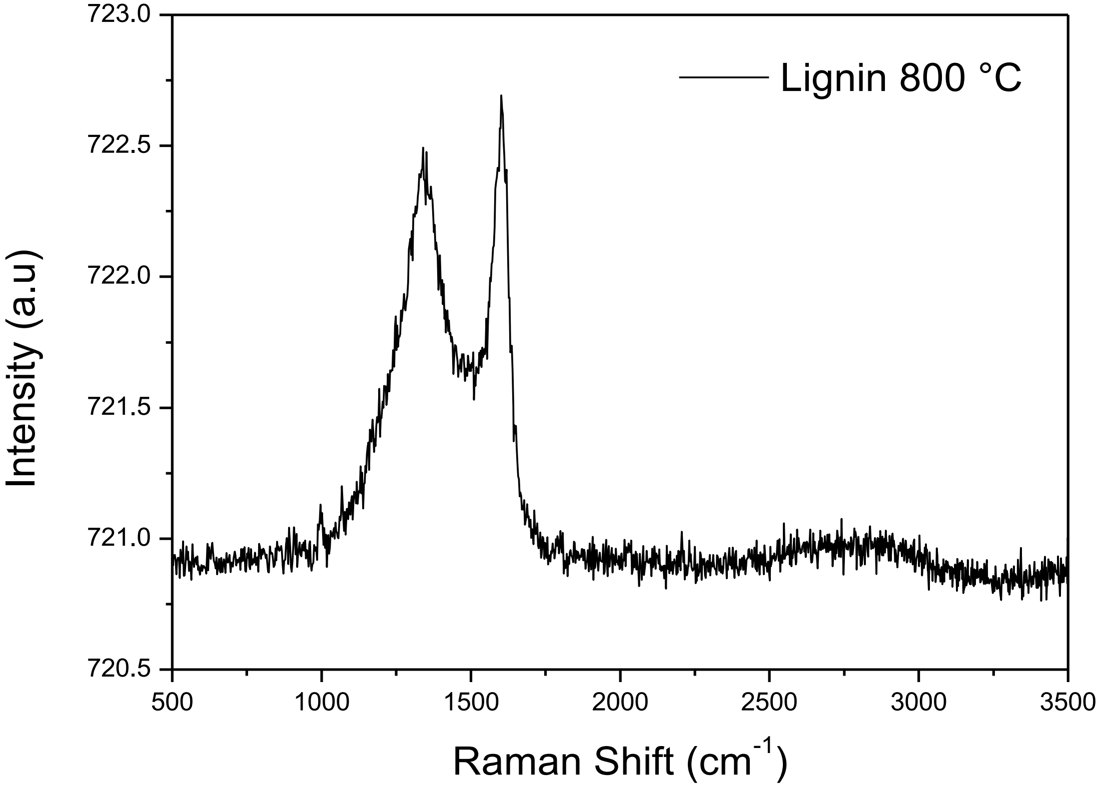


Figure 20: Raman spectra of commercial Lignin as received and pyrolysed at 800°C. Spectra were obtained using a Raman spectrometer with a 532 nm laser excitation source.

X-ray diffraction

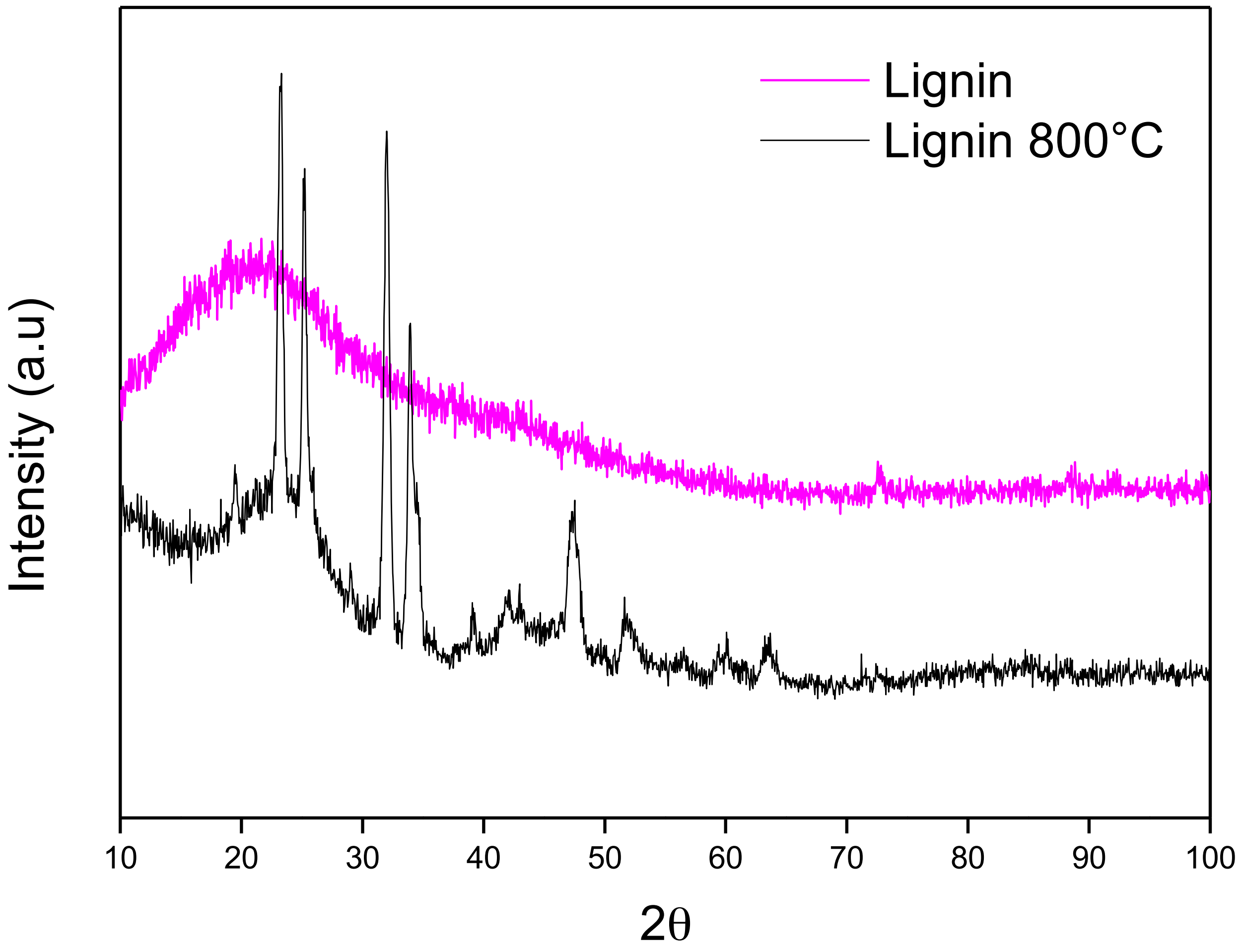


Figure 21: X-ray diffraction results of commercial Lignin and pyrolyzed at 800°C.

Conclusion

Preliminary results after characterization of lignin as received and pyrolyzed at 800 °C showed and increase crystallinity as shown in Raman spectroscopy and X-ray diffraction and surface area with the appearance of pores in the material being this feature very important for the uptake of formaldehyde. Preliminary adsorption results indicate good lignin adsorptive capacity. As a continuation, new characterization and adsorption tests will be carried out on different types of lignin for a quantification of formaldehyde adsorbed on each type of graphitic carbon from lignin.

References

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- Hayashi, J., Kazehaya, A., Muroyama, K., Watkinson, A. P., 2000, Carbon 38, 1873-1878.
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