Electronic Supplementary Information (ESI)

One-Pot Electrocatalytic Lignin Depolymerization with *In-Situ* Extraction: A Feasible Approach Toward Biomass-Based Oils

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Reference reactions

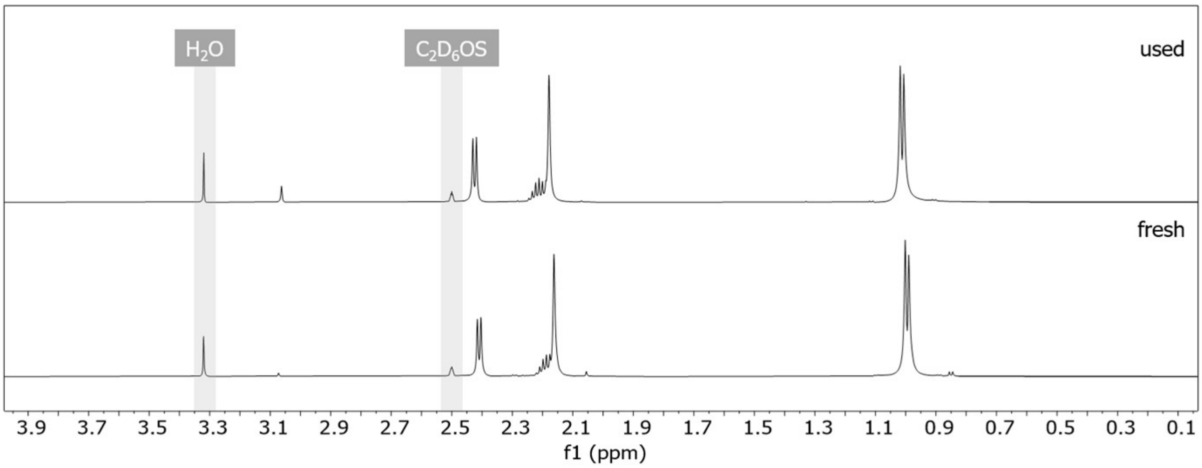


Figure S 1. ^{1}H NMR spectrum (DMSO-d^6, 600.13 MHz) of MIBK (−350 mA/20h/WM/NL) before (fresh) and after (used) reaction.

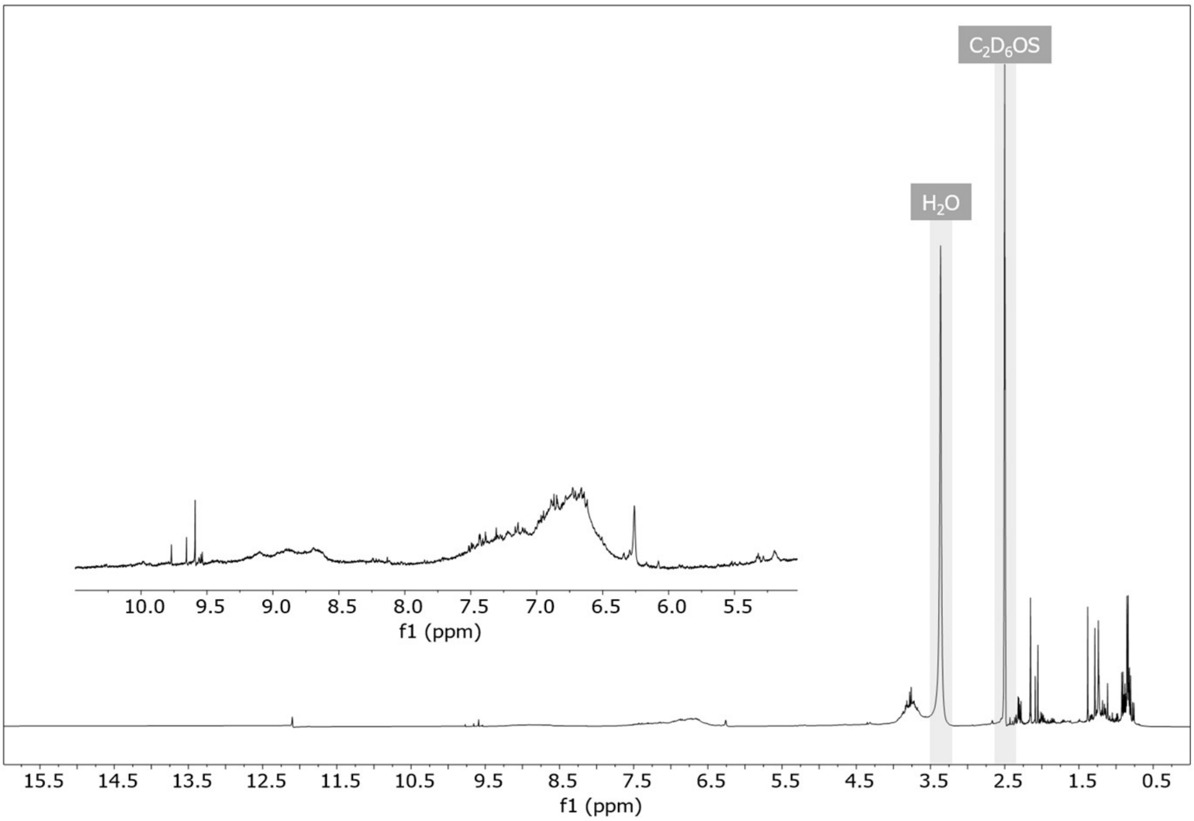


Figure S 2. ^{1}H NMR spectrum (DMSO-d^6, 400.13 MHz) of the MIBK-soluble fraction of lignin (0 mA/20h/LS).

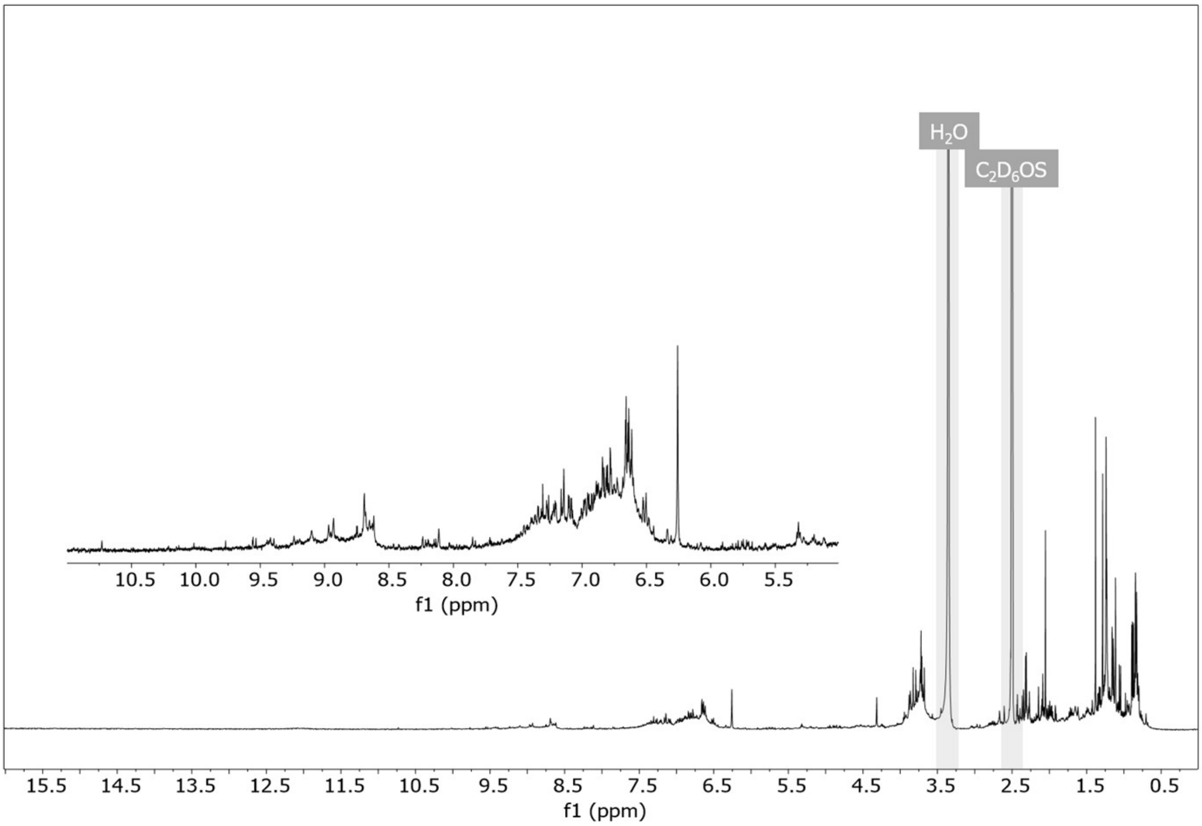


Figure S 3. ^{1}H NMR spectrum (DMSO-d^6, 400.13 MHz) of the MIBK-soluble fraction of lignin without the application of current and directly following the combination of reactants (0 mA/0h/WM).

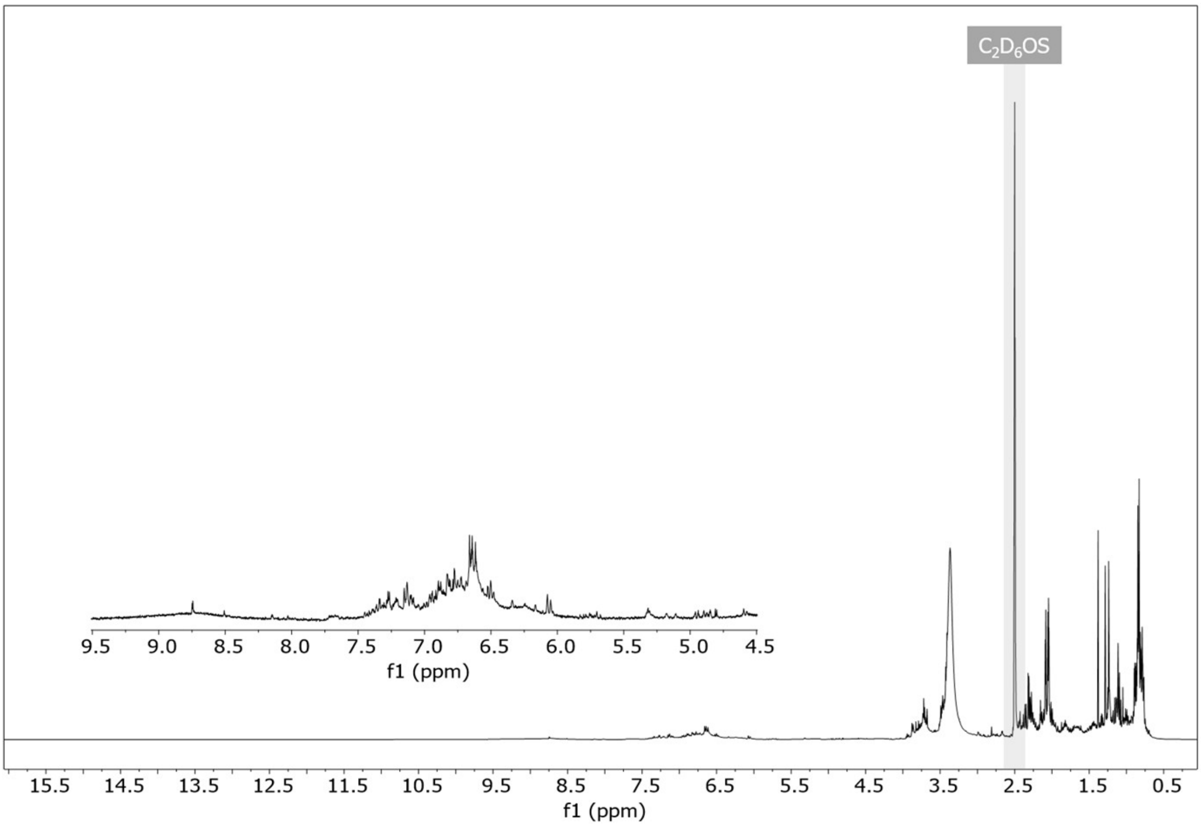


Figure S 4. ^{1}H NMR spectrum (DMSO-d^6, 400.13 MHz) of the MIBK-soluble fraction of lignin without the application of current and after 20 h stirring (0 mA/20h/WM).

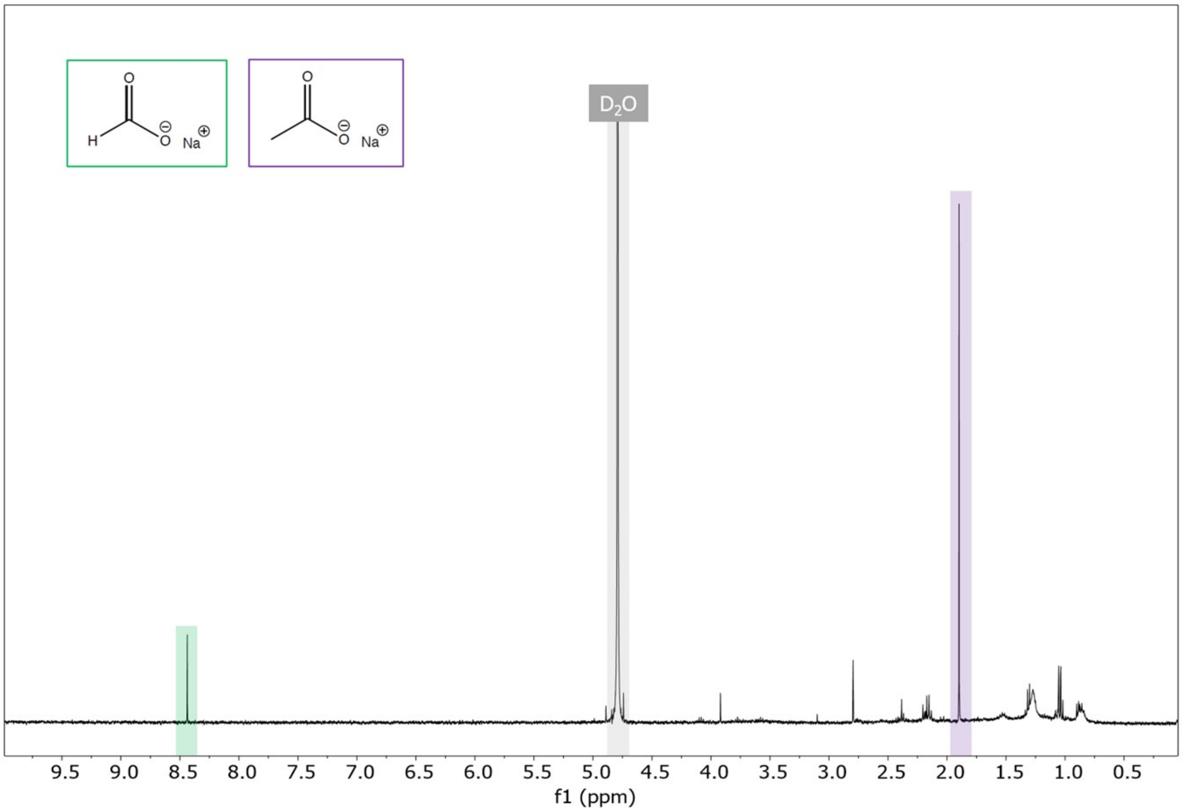
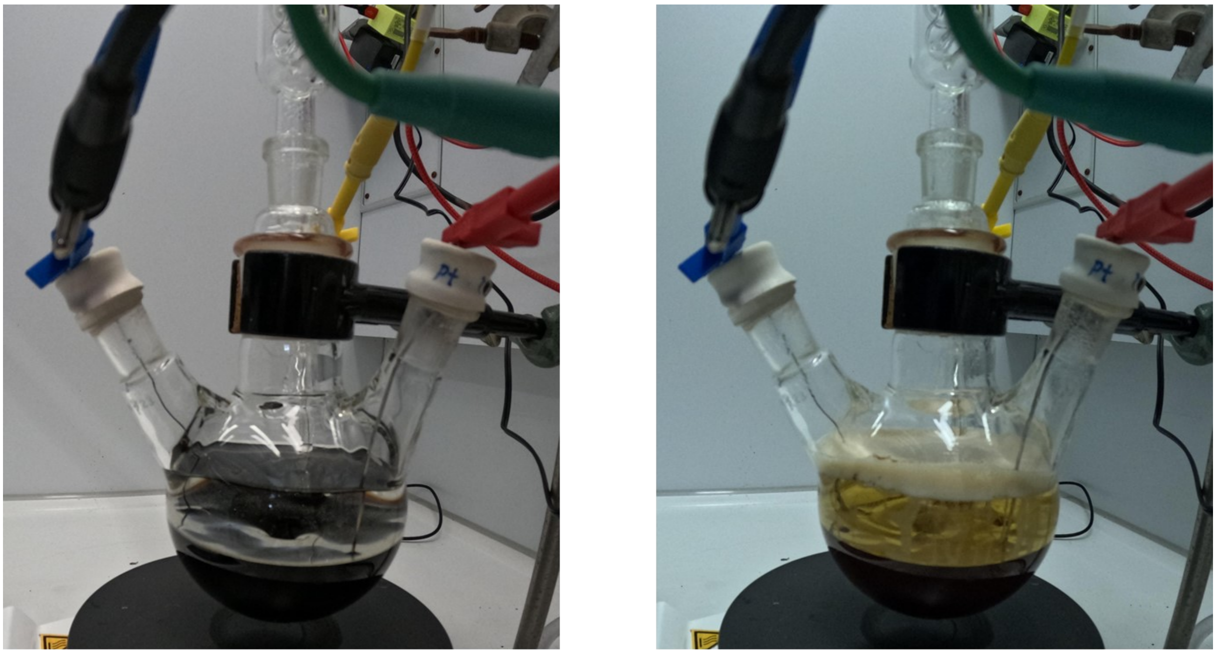


Figure S 5. ^{1}H NMR spectrum (D_2O, 400.13 MHz) of DL without a MIBK layer (−350 mA/20h/NM).

Figure S 6. Decolorization of the reference reaction (−350mA/20h/NM) subsequent to 20 h of depolymerization.

Characterization of depolymerization products derived from the aqueous phase



0 h

20 h

Figure S 7. Color change of the MIBK phase during the electrochemical reaction.

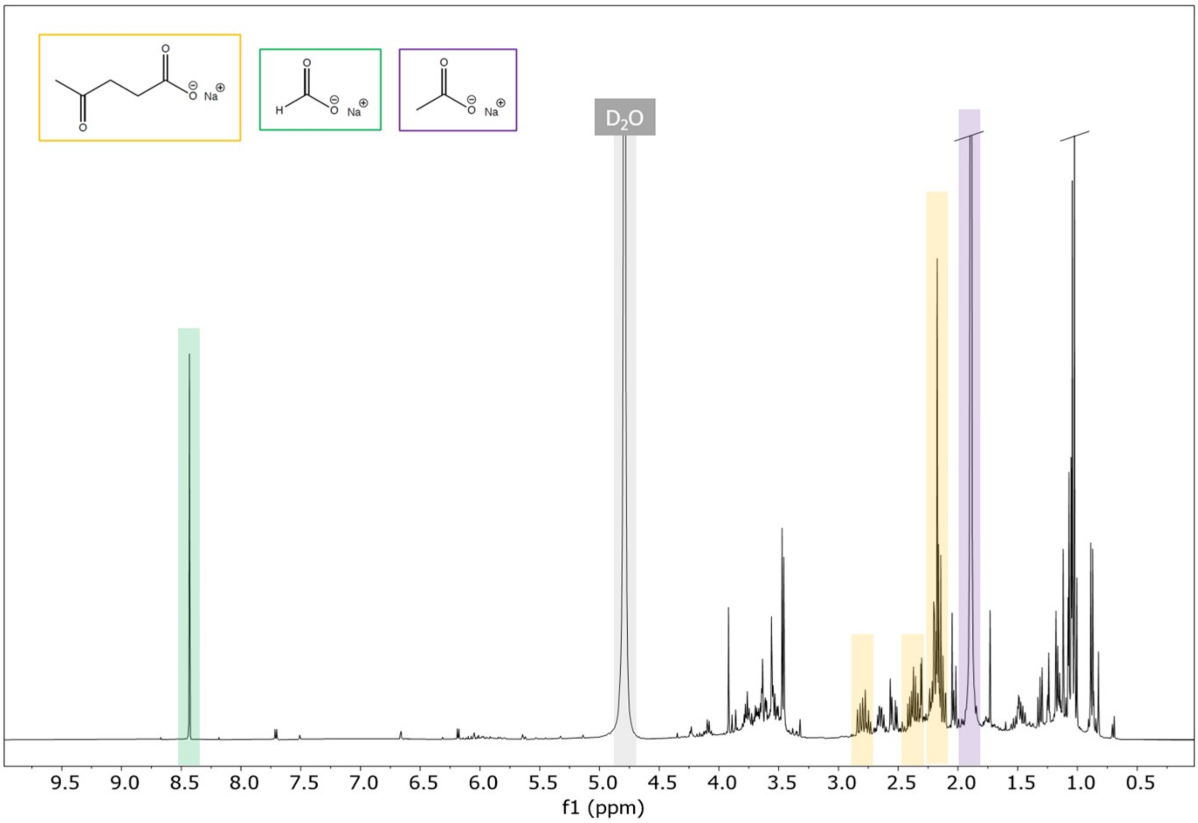


Figure S 8. ^{1}H NMR spectrum (D_2O, 400.13 MHz) of DL.

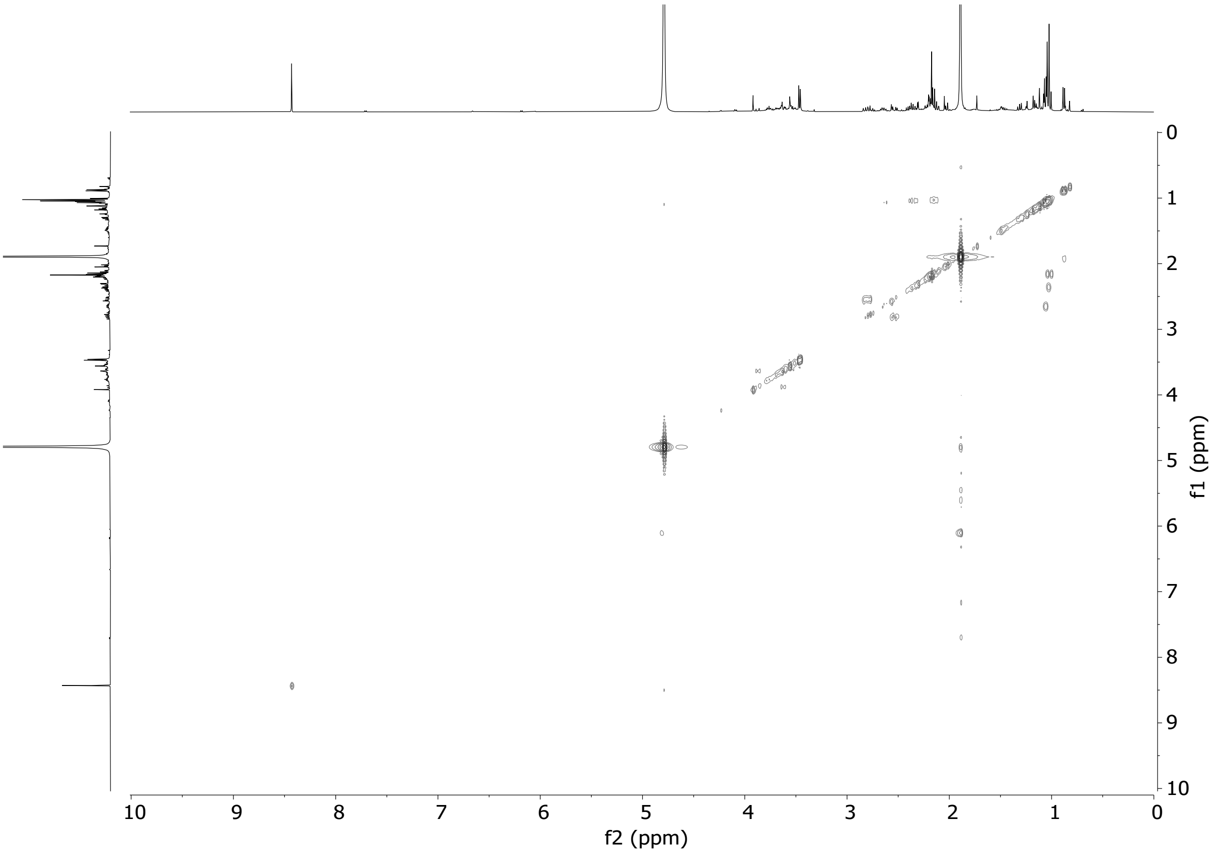


Figure S 9. ^1H ^1H-COSY NMR spectrum (D_2O, 400.13 MHz) of DL.

Characterization of depolymerization products derived from the MIBK phase

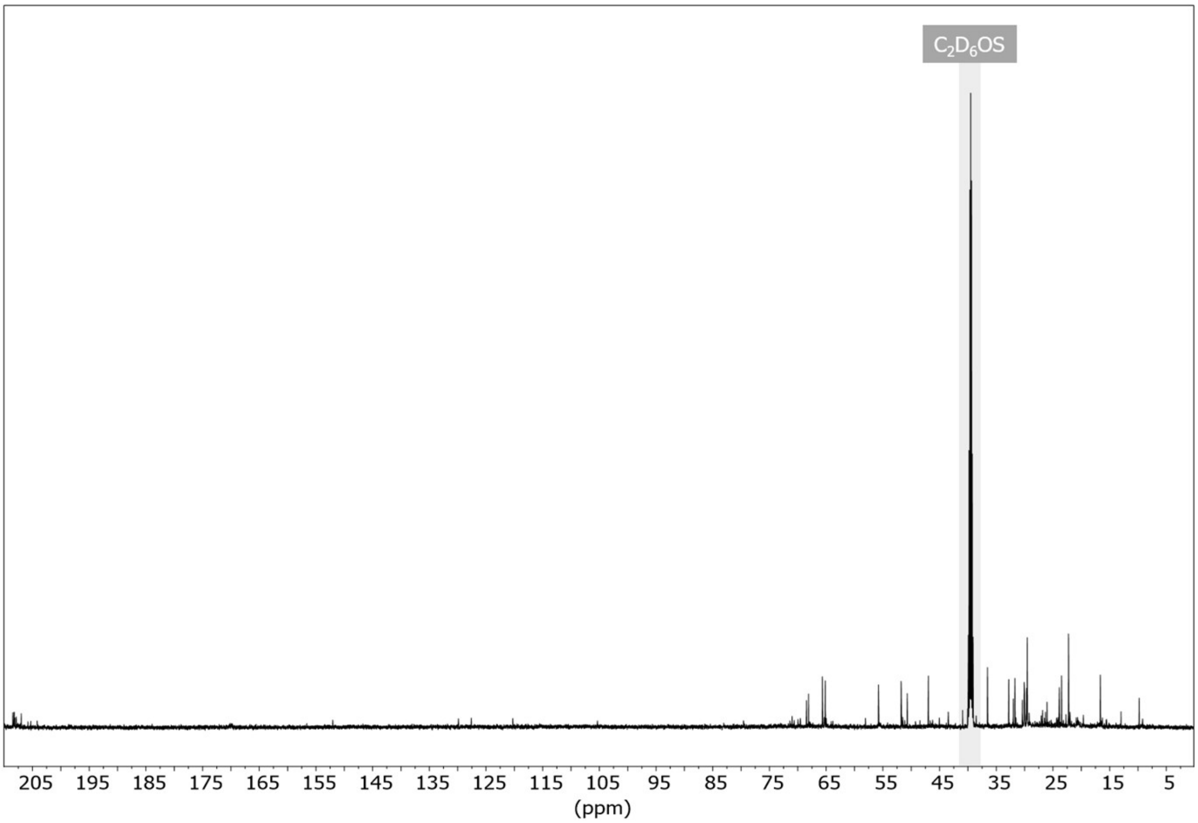


Figure S 10. ^{13}C NMR spectrum (DMSO-d^6, 150.94 MHz) of LO.

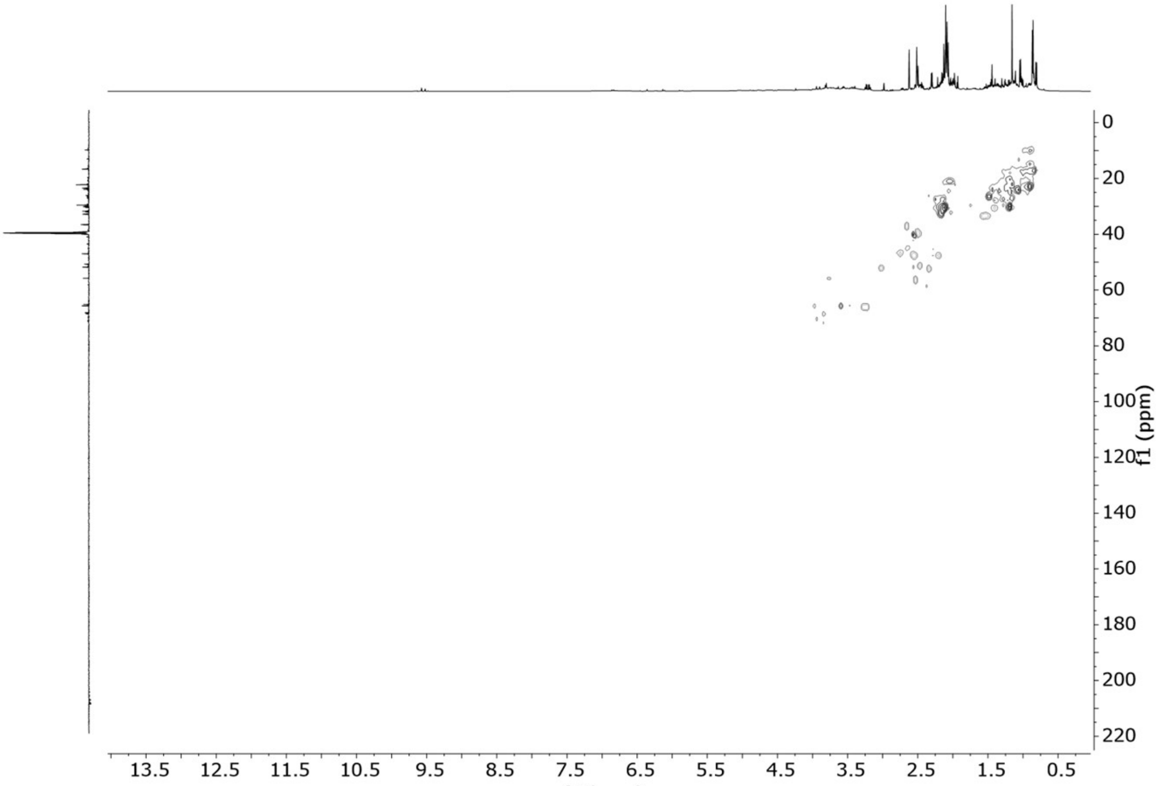


Figure S 11. ^{1}H ^{13}C-HSQC NMR spectrum (DMSO-d^6, 600.13/150.94 MHz) of LO.

Investigation of viscosity, oxidation stability, and thermal stability

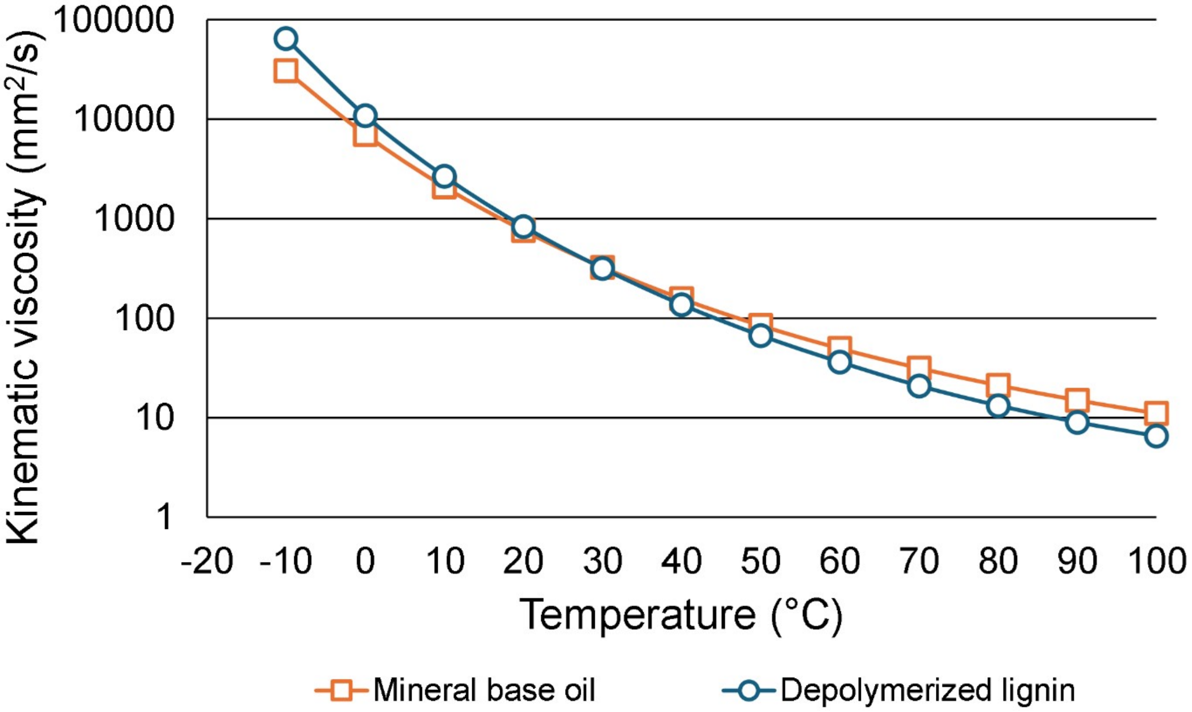


Figure S 12. Temperature-dependent kinematic viscosity of the depolymerized lignin-based oil (blue circles) compared to a commercial mineral base oil (orange squares).

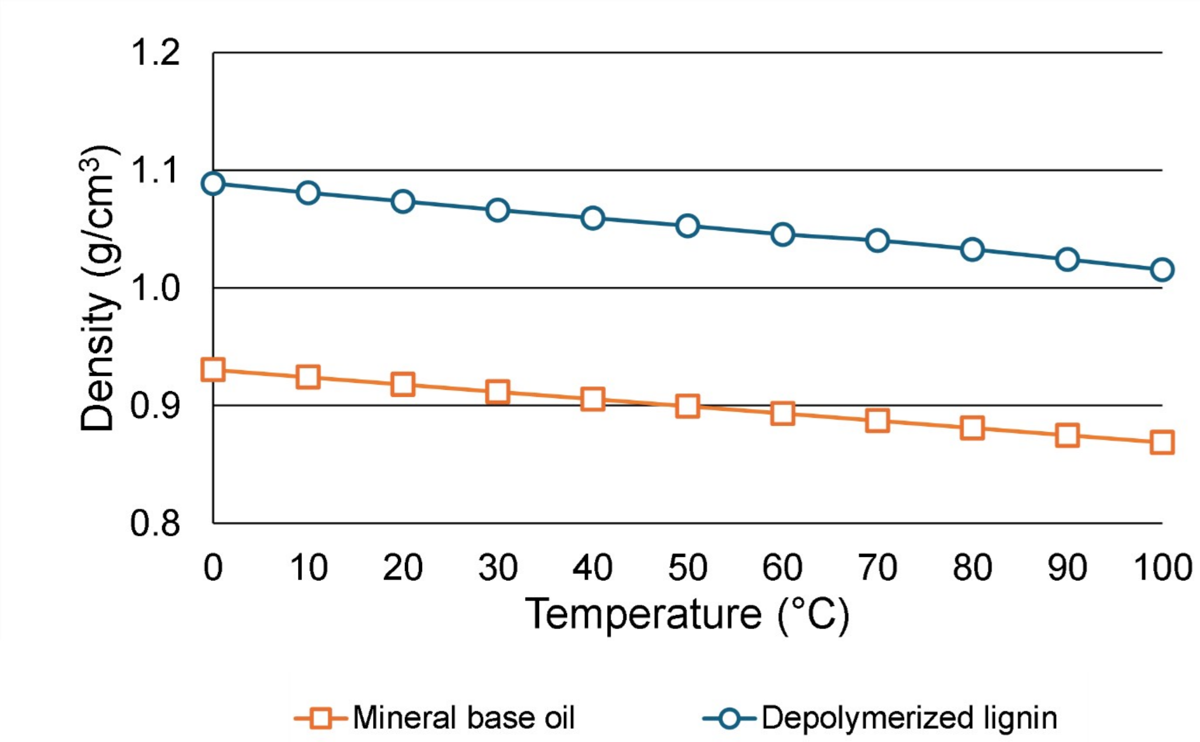


Figure S 13. Temperature-dependent density of the depolymerized lignin-based oil (blue circles) and a commercial mineral base oil (orange squares).

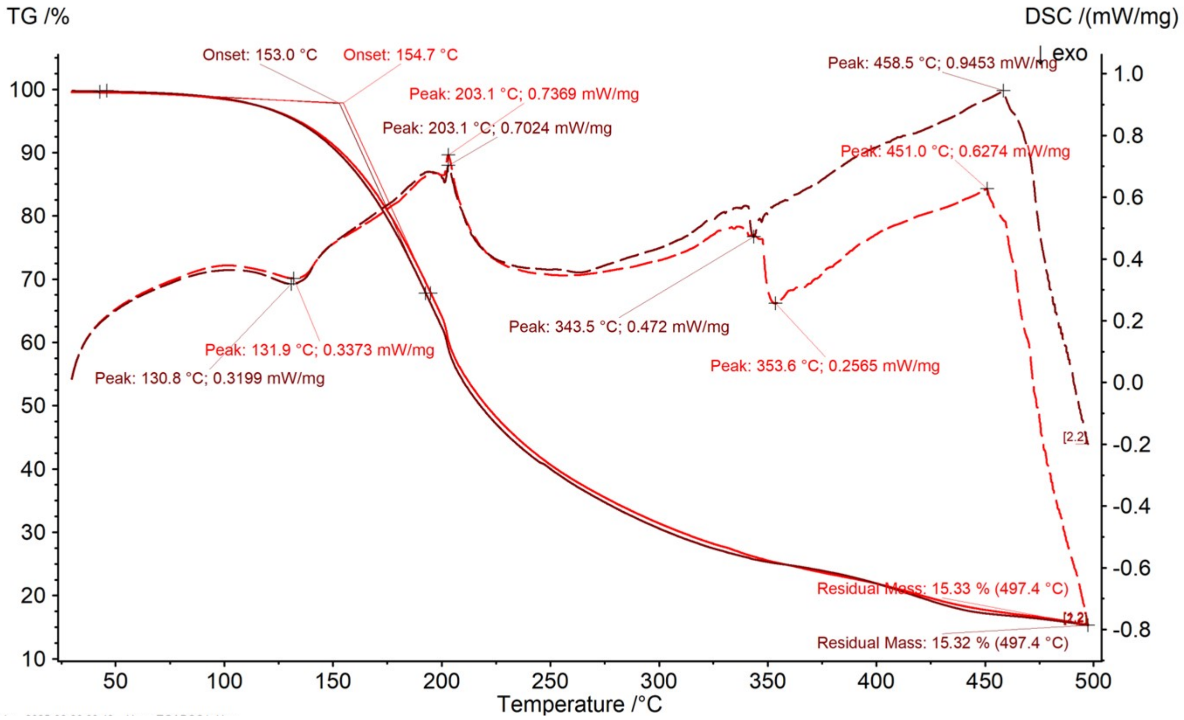


Figure S 14. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) curves of LO were measured under synthetic air (SynAir) atmospheres using a NETZSCH STA 449 F1 Jupiter® device. The protocol encompassed an initial isothermal step at 30 °C for 10 min, followed by heating from 30 °C to 500 °C at a rate of 10 °C min⁻¹. This was succeeded by a final isothermal step at 500 °C for 10 min.

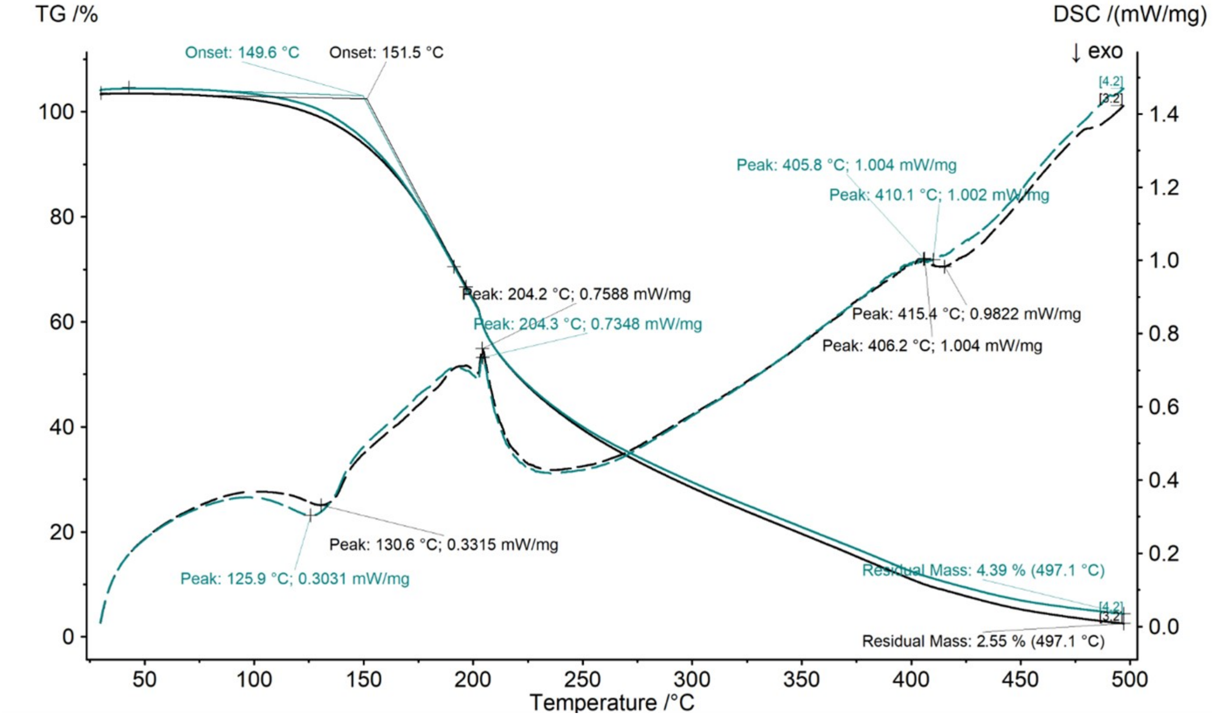


Figure S 15. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) curves of LO were measured under nitrogen atmospheres using a NETZSCH STA 449 F1 Jupiter® device. The protocol encompassed an initial isothermal step at 30°C for 10 min, followed by heating from 30 °C to 500 °C at a rate of 10 °C min⁻¹. This was succeeded by a final isothermal step at 500 °C for 10 min.

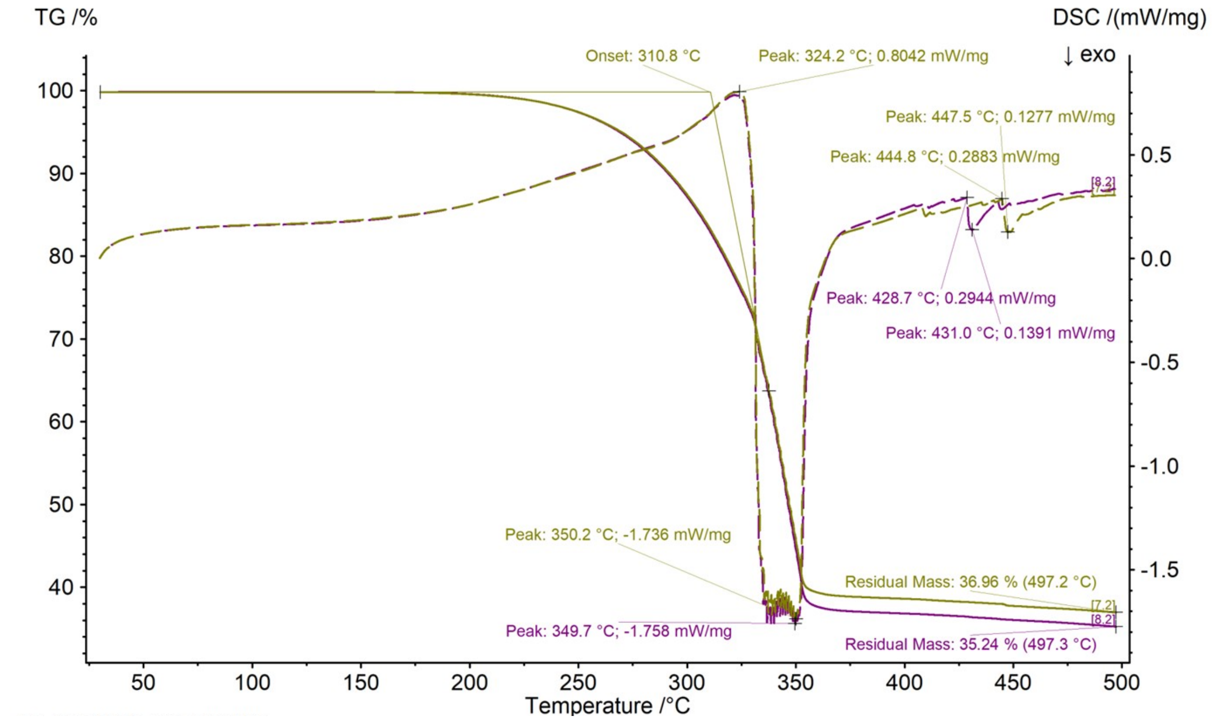


Figure S 16. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) curves of the mineral base oil were measured under synthetic air (SynAir) atmospheres using a NETZSCH STA 449 F1 Jupiter® device. The protocol encompassed an initial isothermal step at 30 °C for 10 min, followed by heating from 30 °C to 500 °C at a rate of 10 °C min⁻¹. This was succeeded by a final isothermal step at 500 °C for 10 min.

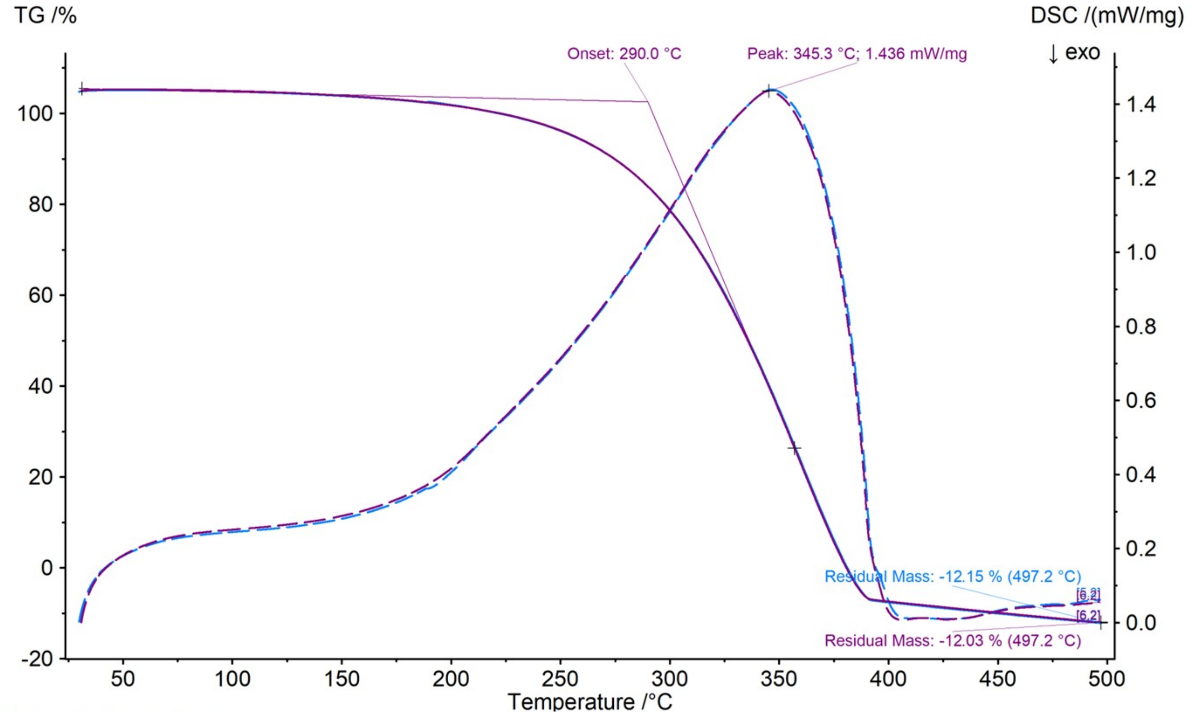


Figure S 17. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) curves of the mineral base oil were measured under nitrogen atmospheres using a NETZSCH STA 449 F1 Jupiter® device. The protocol encompassed an initial isothermal step at 30 °C for 10 min, followed by heating from 30 °C to 500 °C at a rate of 10 °C min⁻¹. This was succeeded by a final isothermal step at 500 °C for 10 min.