Electronic supplementary information

Impact of temperature and *in situ* FeCo catalysis on the architecture and Young's modulus of model wood-based biocarbons

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Table S1. Percentage of yield measured and recalculated from the analysis of the individual components.

Biomass	Un-catalysed				Catalysed			
	Measured	Calculated	Measured	Calculated	Measured	Calculated	Measured	Calculated
	300 °C		700 °C		300 °C		700 °C	
Pin / %	51.8±2.3	49.3	17.6±0.5	23.0	49.1±0.2	39.9	21.5±0.5	23.2
Maple / %	48.7±4.1	50.0	23.4±0.9	24.2	45.2±1.3	41.3	26.8±0.2	24.2

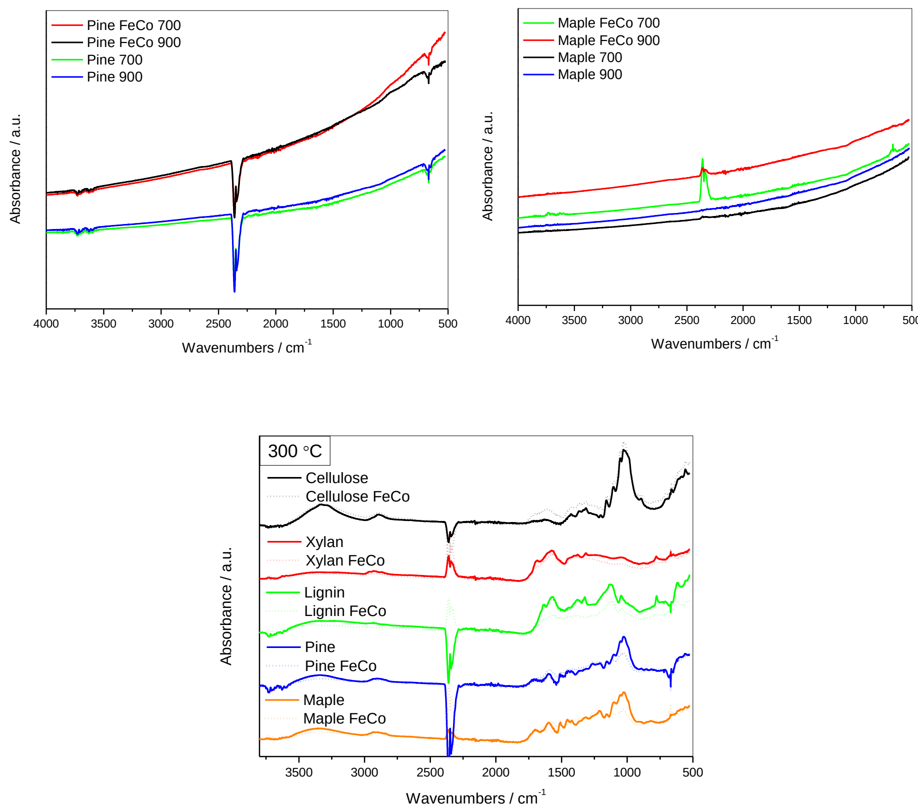

Figure S1. FTIR spectra of the investigated wood and individuals components depending on the temperature and catalysis.

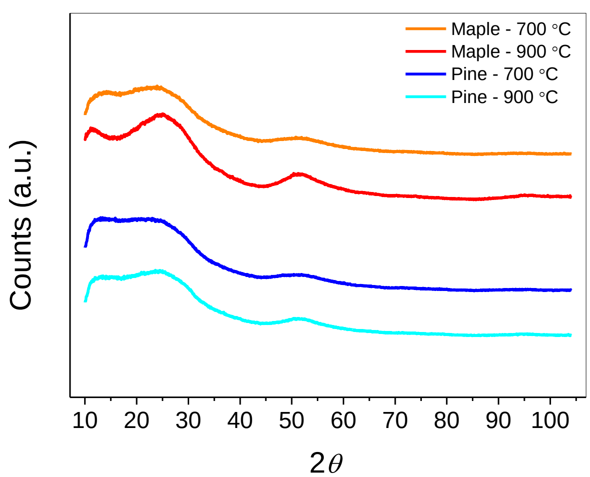

Figure S2. WAXS diffractograms of the un-catalyzed pyrolysed biomass

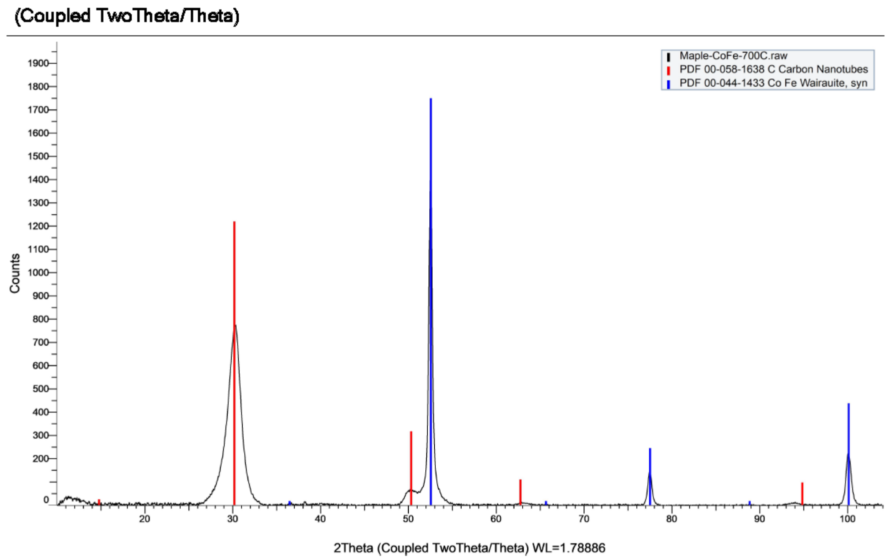

Figure S3. Elucidation of the Maple FeCo 700 C diffractogram.

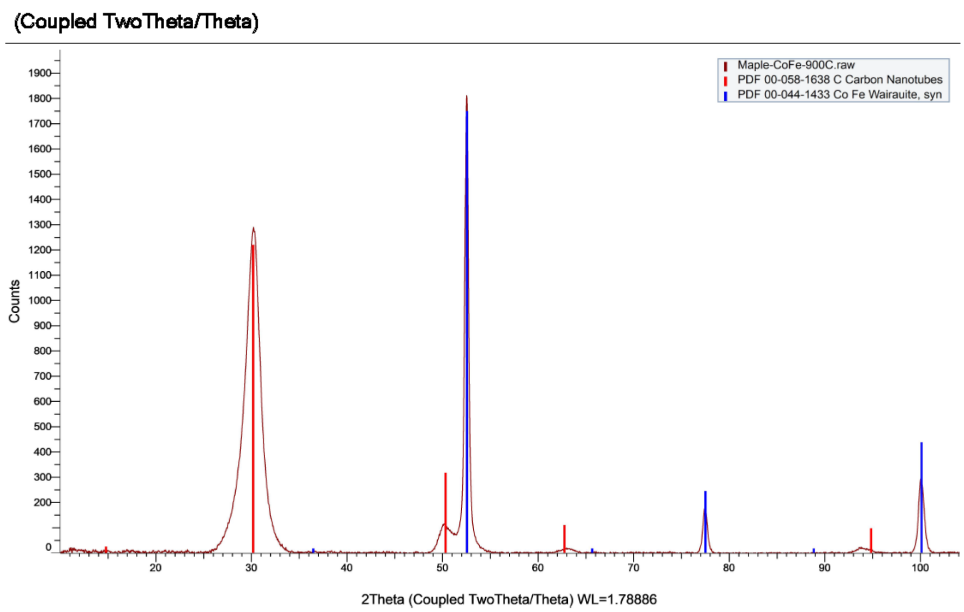

Figure S4. Elucidation of the Maple FeCo 900 C diffractogram.

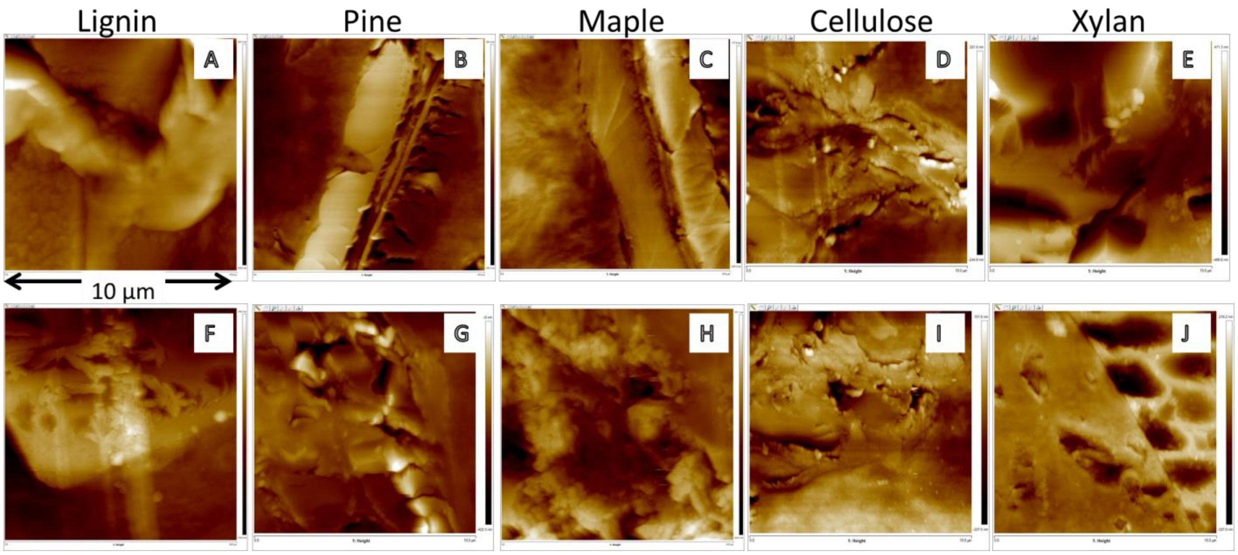

Figure S5. Height images as measured by AFM after pyrolysing at 300 °C different sources of biomasses A-E) without and F-J) with CoFe. The scale is the same for all the images.

Theoretical calculation:

- Weight of introduced Fe and Co:

$$m_{Fe} = \mathrm{n} \times \mathrm{M} = \frac{7.18\times10^{-3}}{2} \times 55.845 = 0.2005 \text{ g}$$

$$m_{Co} = \mathrm{n} \times \mathrm{M} = \frac{7.18 \times 10^{-3}}{2} \times 58.93 = 0.2116 \text{ g}$$

Thus the total amount of introduced metals is:

$$m_{total} = m_{Fe} + m_{Co} = 0.4121 \text{ g}$$

- Volume of one FeCo nanoparticle (as an hypothetic perfect sphere) and the coated graphite:

$$V_{FeCo}(1) = \frac{4\pi \times R^3}{3} \approx 4033\, nm^3, \text{with R} = 9.875$$

$V_{CSP}(1) = \frac{4\pi \times R^3}{3} \approx 13\,648\ nm^3$, with R = 14.825

With $V_{CSP}(1)$ being the total volume of the core-shell particle representing one FeCo spherical nanoparticle coated with one layer of graphite.

Thus the volume of the coated graphite, V_G:

$V_G(1) = V_{CSP}(1) - V_{FeCo}(1) \approx 9614\ nm^3$

- <u>Calculus of FeCo and graphite weight for one core-shell nanoparticle:</u>

We took:

$\rho_G = 2.16\ \mathrm{g.cm^{-3}}$

$\rho_{FeCo} = 8.17\ \mathrm{g.cm^{-3}}$

Thus the weight for one particle:

$m_G(1) = \rho_G \times V_G = 2.16 \times 9.614 \times 10^{-18} \approx 2.08 \times 10^{-17}$ g

$m_{FeCo}(1) = \rho_{FeCo} \times V_{FeCo} = 8.17 \times 4.033 \times 10^{-18} \approx 3.29 \times 10^{-17}$ g

- <u>Total amount of generated graphite for the amount of introduced metal, considering the ideal model of perfectly coated FeCo nanoparticles :</u>

Total number of FeCo nanoparticles, TN_{FeCo}:

$\mathrm{TN}_{FeCo} = \frac{m_{total}}{m_{FeCo}} = \frac{0.4121}{3.29 \times 10^{-17}} \approx 1.25 \times 10^{16}$ nanoparticles

Thus, the total weight of generated graphite, m_G, is this ideal case would be:

$m_G = \mathrm{TN}_{FeCo} \times m_G(1) = 1.25 \times 10^{16} \times 2.08 \times 10^{-17} \approx 0.26$ g

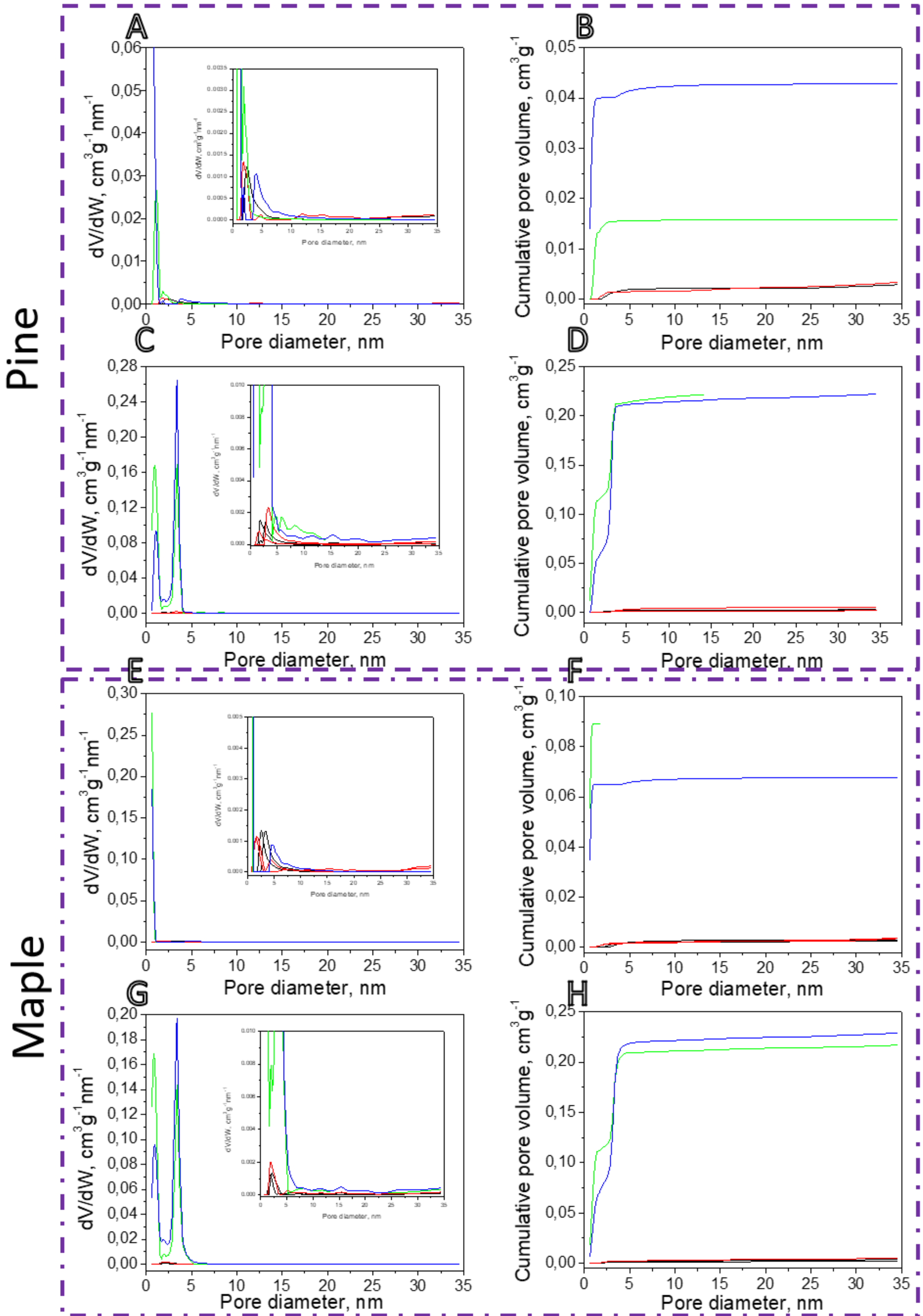

Figure S6. A,C,E,G) Pore size distribution and B,D,F,H) cumulative pore volume for samples A-D) Pine and E-H) Maple, with C,D,G,H) in presence of catalyst.

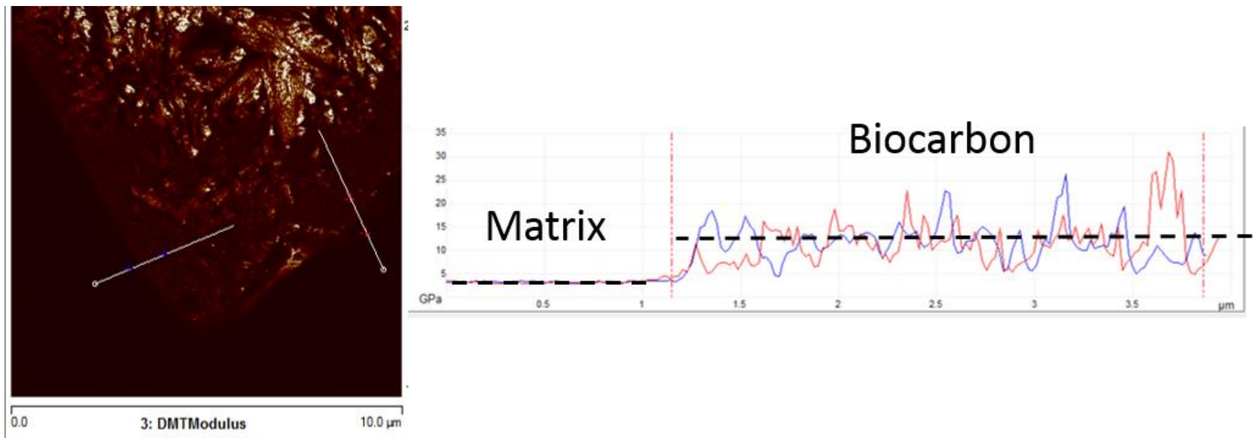

Figure S7. AFM imaging and automatically calculated Young’s modulus