Supplementary information

Biomass screening for syngas production by flash photopyrolysis

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1.   **Moisture determination**. The weighted samples in crucibles without the covers are heated with a heating rate (15–50 C/min) from room temperature to 105 °C, followed by a 105 °C isothermal hold for 3 min under inert atmosphere (nitrogen, argon or helium). The moisture content is calculated by the following formula:

$$Mo = \frac{(W - B)}{W}$$

where W is the mass of the sample used, B is the mass of the sample after drying in moisture test.

2.   **Volatile matter determination.** Then a heating ramp (50– 100 C/min) is programmed until 950 °C, and a cooling process starts with a cooling rate (−50 to −100 C/min) until 450 °C. The volatile matter content is calculated by the following formula:

$$VM = \frac{(B - C)}{W}$$

where C is the mass of the sample after heating in volatile matter test.

3.   **Ash determination.** The flow gas is changed to oxidizing gas (oxygen or air), then a heating ramp begins until 800 °C, followed by an 800 °C isothermal hold for 3 min. The ash content is calculated by the following formula:

$$A = \frac{D}{W}$$

where D is the mass of the residue remaining after the ash test.

4.   **Fixed carbon determination.** The fixed carbon content is calculated according to the following equation:

$$FC = 1 - M - VM - A$$

Figure S1 - (a) Scheme of the photo-pyrolysis system with heat resistant table (inset 1) and Xenon flash lamp (inset 2) and (b) power supply (PulseForge 1300 photonic curing system, Novacentrix, USA).
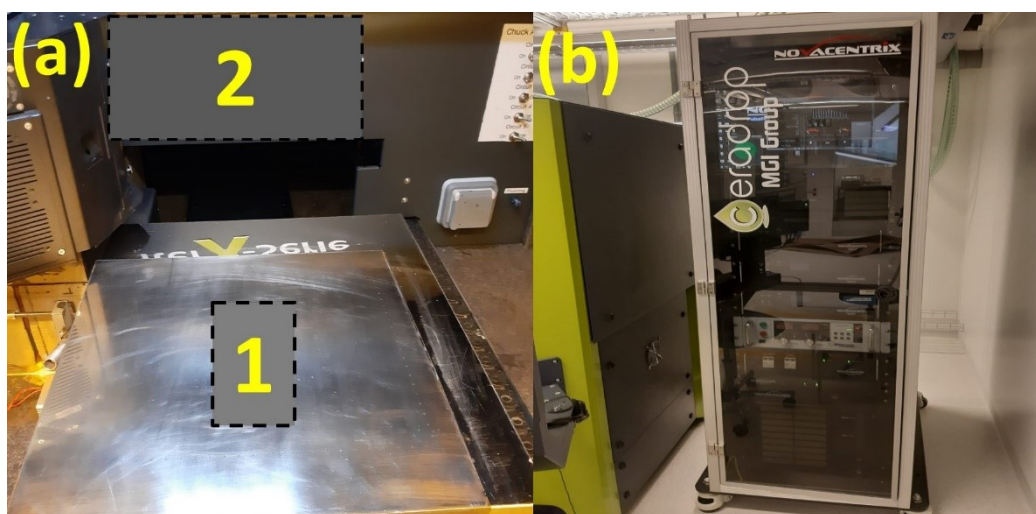
Flash photopyrolysis main reactions

Biomass + flash irradiation (flash pyrolysis) $\leftrightarrow$ C + H_2 + CO + CH_4 + C_2H_4 + CH_3CHO + H_2 + Tar + Char

Tar + flash irradiation (flash pyrolysis) $\leftrightarrow$ H_2 + CO + CH_4 + CO_2 + C_2H_4 + CH_3CHO + Char

C + H_2O $\leftrightarrow$ CO + H_2 (primary carbon-steam reaction)

2C + O_2 $\leftrightarrow$ 2CO (Partial oxidation)

C + O_2 $\leftrightarrow$ 2CO (Boudouar reaction)

C + O_2 $\leftrightarrow$ CO_2 (Carbon oxidation)

CH_4 + CO_2 $\leftrightarrow$ 2CO + $2H_2$ (Dry reforming)

CH_4 + H_2O $\leftrightarrow$ CO + $3H_2$ (Steam reforming)

C + $2H_2$ $\leftrightarrow$ CH_4 (Hydrogasification reaction)

CO + $3H_2$ $\leftrightarrow$ CH_4 + H_2O (Methanation)