SOLSTICE	Name of the PhD candidate : **Rui LI** Title of the PhD thesis: **Solar pyrolysis of agricultural by-products and metal-polluted biomass.** Dates (start/end): 01/10/2015 – 30/09/2018
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Context and objectives

The conversion of agricultural by-products and wood into bio-fuels is largely concerned in many countries. Pyrolysis is one of the most attractive processes to convert biomass into gas, bio-oil and bio-char. Implementing concentrated solar energy as heat source for the pyrolysis reactions can increase the energy conversion efficiency of the process (energy content of the products), the use of chemical element resource (carbon and hydrogen) and reduce pollution discharge. On the other hand, biomass is often used for depolluting soil-containing metals. In this context, the objectives of the PhD thesis are, (1) to develop a versatile experimental setup to perform solar biomass pyrolysis in well-controlled conditions; (2) to measure the products, in particular the gas, composition; (3) to quantify the effect of metals on pyrolysis process and products; (4) to model and simulate the solar pyrolysis of biomass.

Approach

Figure 1a and 1b shows the experimental setup. It is associated with a 1.5 kW solar furnace equipped with a solar flux (sample temperature) controller enabling to control the heating rate and the plateau temperature during pyrolysis in the range 10-450 °C/s and 600-2000°C respectively. Product distribution and gas composition are measured for every experiments. In parallel, both thermodynamic and process modeling are develop in order to understand the chemistry and the transport phenomena governing the pyrolysis process.

Main results

Solar pyrolysis of pine and beech wood sawdust, peach pit, grape stalk and grape marc was conducted. Water content was also varied for beech wood. The gas yield increases drastically with temperature (up to about 65% at high temperature) and the H2/CO ratio can exceed unity in some experimental conditions depending on the biomass composition. The model described satisfactorily the experimental data as illustrated in Figure 2.

We will focus future work on metal-polluted biomass.

Figure 1a. The solar reactor

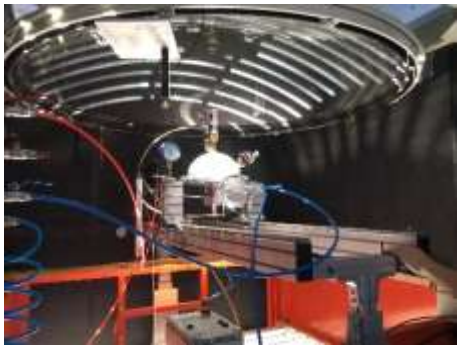

Figure 1.b. Photo of the solar pyrolysis reactor

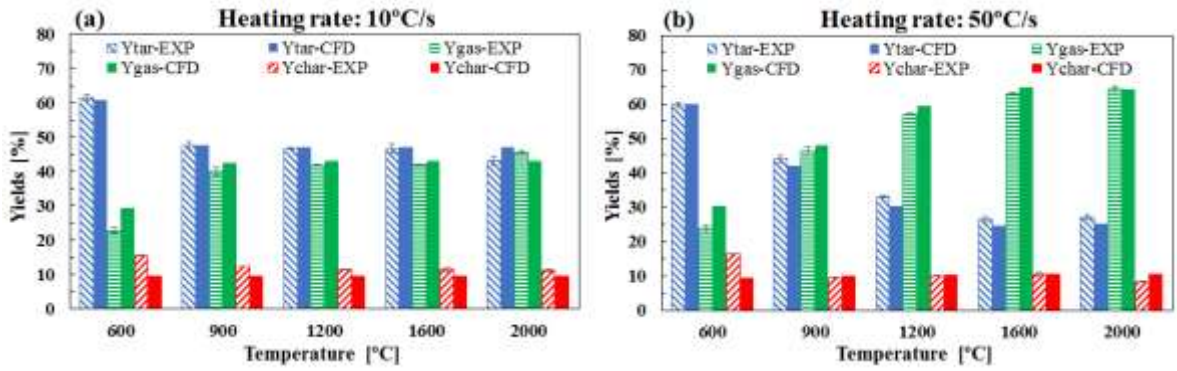

Figure 2. Comparison of experimental and simulation results (gas, tar and char yield as a function of pyrolysis temperature

Publications in scientific journals

Li R., Zeng K., Soria J., Mazza G., Gauthier D., Rodriguez R., Flamant G. « Product distribution from solar pyrolysis of agricultural and forestry residues". Renewable Energy (2016), 89, pp. 27-35.

Zeng K., Gauthier D., Li R., Flamant G.« Combined effects of initial water content and heating parameters on solar pyrolysis of beech wood » Energy (2017), 125, pp. 552-56; 10.1016/j.energy.2017.02.173