

01. ABSTRACT

The smoke during the combustion of plywood with APP was qualitatively and quantitatively analyzed by TG-FTIR, cone calorimeter coupled with solvent absorption device (CONE-SA), and the fractional effective dose (FED) model was established to evaluate the smoke toxicity.

02. INTRODUCTION

- The smoke toxicity caused by fire is one of the main causes of death.
- The addition of flame retardants of wood makes the composition of smoke generated by wood combustion more complex.
- With the CONE-SA in our work, the emission yields of the main toxic gases were measured.

03. MATERIALS & METHODS

- The samples were made by eucalyptus, MUF and APP.
- The samples were characterized by element analyzer, TG-FTIR and CONE-SA.
- FED model was established to evaluate smoke toxicity of samples.

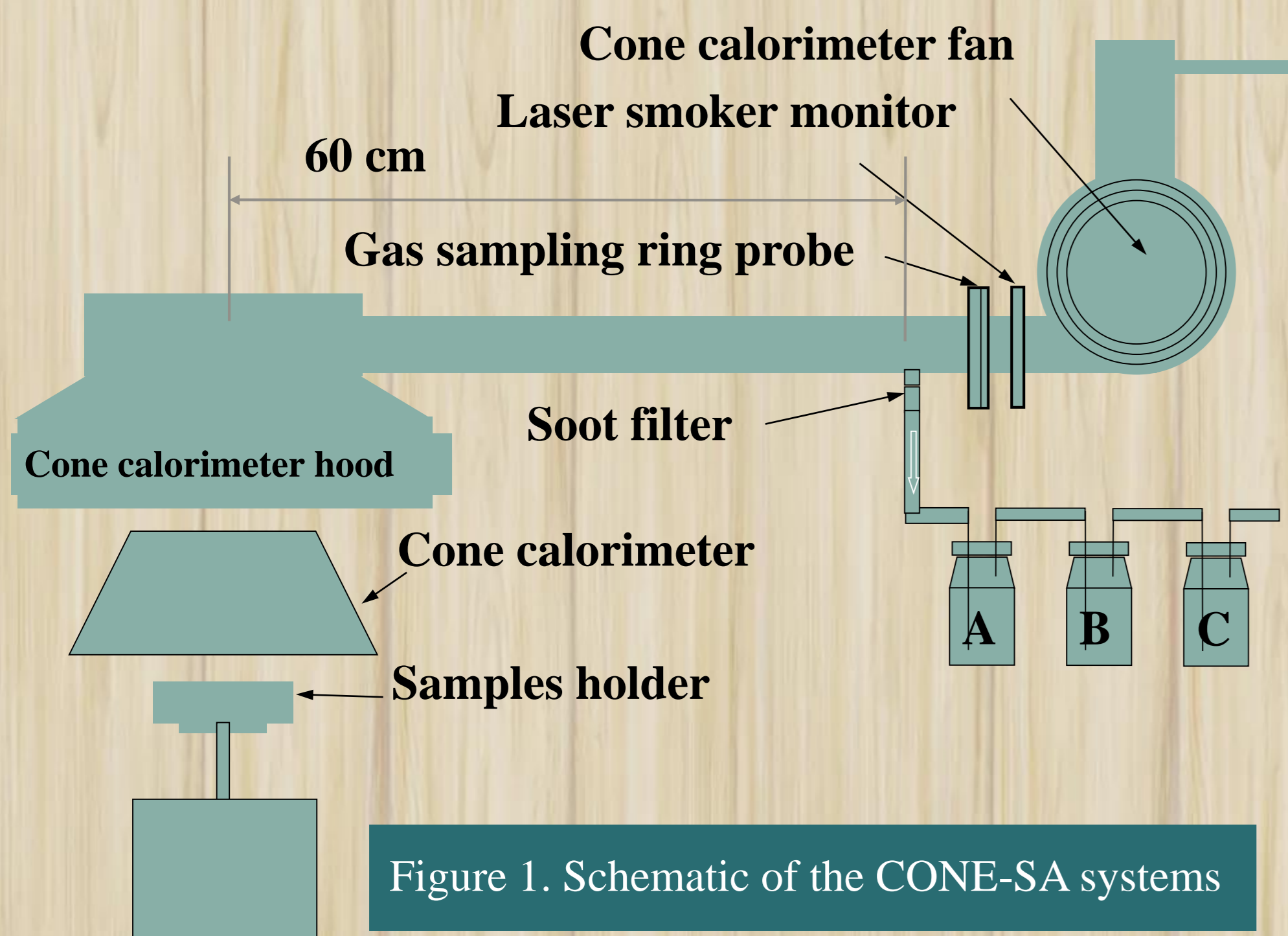


Figure 1. Schematic of the CONE-SA systems

04. RESULTS & DISCUSSION

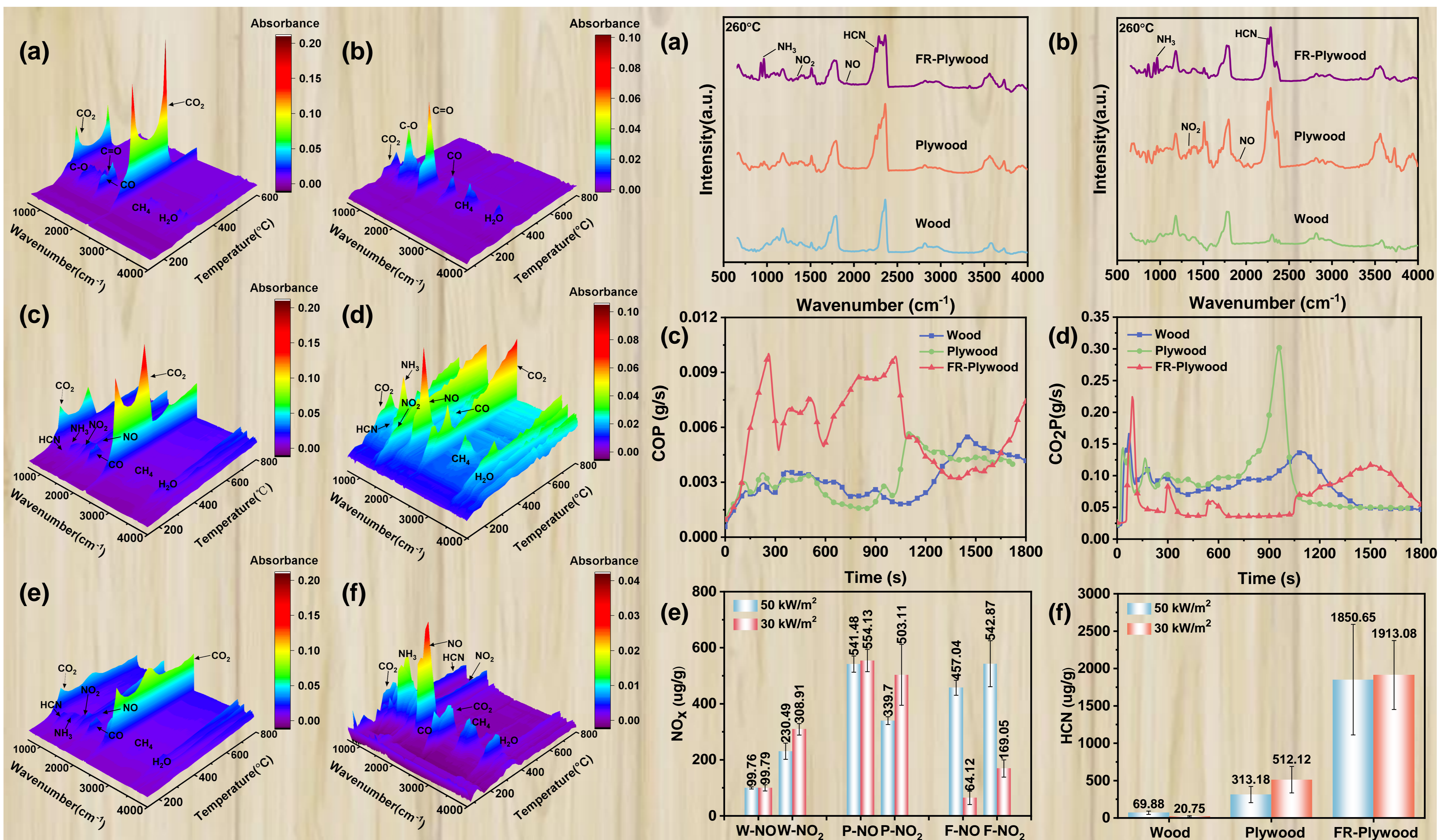


Figure 2. 3D TG-IR spectra of Wood (a, b), Plywood (c, d), FR-Plywood (e, f) under the air (a, c, e) and argon (b, d, f) atmospheres.

Figure 3. FTIR of the volatiles of three samples under air (a) and argon (d) atmosphere, the amount of smoke generated by CONE-SA (b, c, e, f)

- After adding MUF and APP, some poisonous gases such as NO, NO₂, HCN appeared.
- In the early stage of combustion, the CO emission rate of FR-Plywood was higher than that of the other two samples, but CO₂ emission rate was the opposite.
- The NO_x emission yields were decreased much with the addition of APP at lower heat flux.
- At 50 kW/m², the NO_x emission yield of FR-Plywood was higher 1.13 times than that of Plywood.
- The HCN production of FR-Plywood was much higher than that of the other two samples.

Table 1. Smoke toxicity parameters of the three materials (calculated by the mean value of the emission yields of gases over burn time)

Parameters	Wood		Plywood		FR-Plywood	
	50 kW/m ²	30 kW/m ²	50 kW/m ²	30 kW/m ²	50 kW/m ²	30 kW/m ²
FED _{CO}	27.4	42.6	28.0	46.6	85.6	90.5
FED	33.9	49.2	44.8	69.1	148.8	143.6
LC ₅₀ (g/m ³)	270.4	176.1	208.8	130.2	64.2	55.1

- From the FED model, it can be seen that the smoke toxicity of FR-Plywood was greater than that of Wood and Plywood whether under 50 kW/m² or 30 kW/m².

05. CONCLUSIONS

- TG-FTIR results showed after adding MUF and APP, some poisonous gases such as NO, NO₂, HCN appeared.
- The HCN and NO_x emission yield of FR-Plywood was higher 5 times and 1.13 times than that of Plywood at 50 kW/m².
- The results of FED model showed that LC₅₀ values of FR-Plywood were about 3.3 times that of Plywood at 50 kW/m².
- The results obtained in this work could be used as a guidance to choose and use the adhesive and flame retardant.

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