Thermal conductivity measurement of biomass-based oxygenated compounds using microfluidics

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Concentrations of greenhouse gases (GHGs) in the atmosphere are rising rapidly, with the combustion of fossil resources responsible for a large part of the human induced carbon dioxide (CO_2) emissions. In order to minimize related environmental issues as warming and climate change effects, it is necessary to reduced GHGs emission. There exist various ways to reduce GHGs emitted by industries, and the use of biomass-based energy can play a crucial role. Biomass-based fuels (biofuels), containing oxygenated compounds, is considered as the renewable fuel with the highest potential for sustainable development in the near the future (*1*). To convert biomass into useful forms of energy, it is necessary to go through a wide range of conversion processes, and the design of such processes need as support, thermophysical properties (*2*).

Thermophysical properties are used to evaluate performance parameters of a thermal system, for example, heat transfer coefficient (HTC), pressure drop and energy efficiency. Among the thermophysical properties, thermal conductivity is considered as the most important property of any fluid for heat transfer applications (*3*). The need for such experimental data concerning oxygenated compounds is important since they are still scarce in the literature.

There are various methods to measure thermal conductivity, and depending on the equipment used the measurement can be time consuming and/or requires important quantities of products, which induces a major impact financially and industrially. Microfluidics have been proven as an appropriate support to overcome these issues with promising results in science applications (*4*) and data acquisition (*5*). It offers extraordinary capabilities explained by its low reagent consumption, fast screening, low operating time, in situ analyses, improvement of heat and mass transfers, etc. In addition, over the last 10 years, a new field of investigation called "high pressure and high temperature microfluidics" (HP-HT) has gained great interest (*6*). It combines the advantages of microfluidics with fluid systems used under HP-HT conditions. Indeed, such conditions have an important interest as they provide responses considering the real needs in the industry.

In this presentation, we will mainly focus on thermal conductivity measurement using microfluidics in HP-HT conditions. We will first present thermal conductivity and its methods of measurement. Then, we will detail the interest of microfluidics and its contributions for thermal conductivity measurements, highlighting advantages and disadvantages of the existing works.

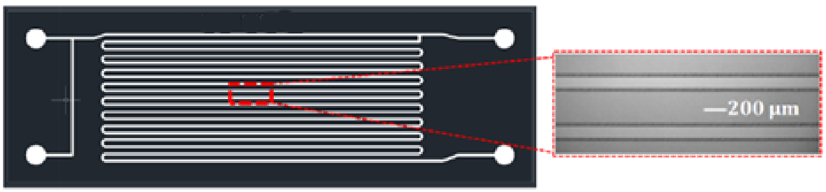

Figure 1: Schematic of the HP-HT microfluidic device with an illustration of the observed zone (red frame) (*7*)

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