

Rapid screening for optimum reaction temperature in Fischer-Tropsch synthesis

[Background] Fischer-Tropsch (FT) synthesis converts the syngas, a mixture of H₂ and CO, to hydrocarbons. The flexibility of FT synthesis is attractive, since the syngas can be produced from several different sources such as natural gas and bioethanol. The product distribution is known to vary significantly depending on the catalysts and reaction conditions. This report shows how simple, Single micro-Reactor can be used to quickly and easily characterize the catalytic conversion of the syngas to hydrocarbons and optimize the reaction temperature.

[Experimental] A catalyst-screening system based on a Single micro-Reactor (Rx-3050SR, Frontier Labs) directly interfaced to the GC injector of a GC/MS system (Fig. 1) was used for the analysis. Carbon monoxide and hydrogen were used as the reaction gas (CO/H₂ = 1/2). A quartz catalyst tube (i.d. 3 mm) packed with the catalyst (5% Ru-Al₂O₃, weight 90 mg, height 15 mm) was placed in the micro-Reactor. The reaction temperature was programmed from 100 °C to 400 °C at 10 °C/min. The products formed were monitored in real time using the characteristic ion of each component.

[Results] The results of the real time monitoring are shown in Fig. 2. As the reactor temperature increases, carbon monoxide decreases while olefin and paraffin formation increases. The olefin formation maximizes at around 260 °C, and the paraffin formation maximizes at around 270 °C. At higher temperatures, only methane, water and carbon dioxide were produced. As shown in Fig. 2, the optimum temperature for hydrocarbon formation can be obtained within 30 min.

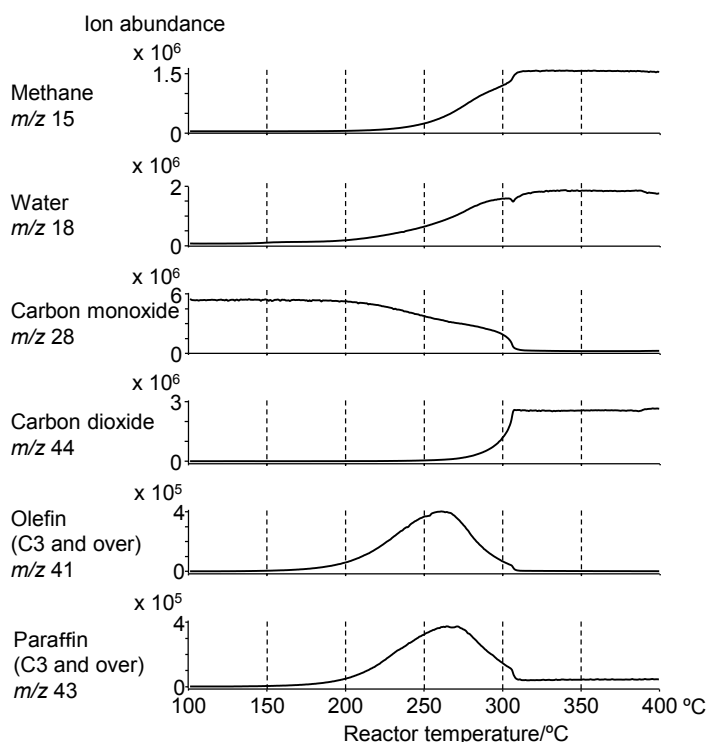
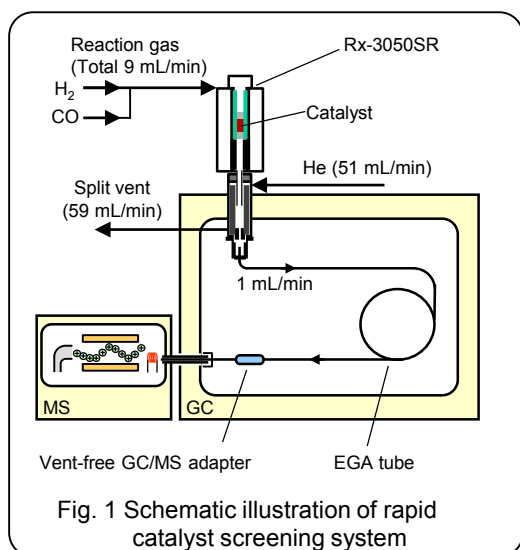


Fig. 2 Extracted ion chromatograms in real time monitoring

Reactor temp.: 100 – 400 °C (10 °C/min),
 EGA tube: UADTM-2.5N (L=2.5 m, i.d.=0.15 mm),
 Column flow rate: 1 mL/min (He), Split ratio: 1/60, GC oven: 300 °C,
 MS scan range: m/z 10 – 200,
 Reaction gas: carbon monoxide (3 mL/min), hydrogen (6 mL/min),
 Catalyst: 5% Ru-Al₂O₃, Space velocity (GHSV): ca. 5,100/h.

Keywords : Fischer Tropsch (FT) synthesis, Ruthenium catalyst, catalytic reaction screening

Products used : Single micro-Reactor, UA-DTM, Vent-free GC/MS adapter

Applications : Energy, Petrochemistry, Catalyst

Related technical notes : [RXA-004E](#)

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