Conversion of ethanol to ethylene using Tandem μ-Reactor GC/MS system – Part 1

[Background] The Tandem μ-Reactor GC/MS system designed for the rapid screening and evaluation of catalysts is described in Technical Note (RXT-001E). This technical note illustrates how the Tandem μ-Reactor GC/MS system can be used to characterize the catalytic conversion of ethanol to ethylene.

[Experimental] The system configuration is shown in Fig. 1. A zeolite catalyst (H-ZSM-5, 3ϕ x 10 mm) was packed in a quartz insert tube which was placed in the 2nd reactor. A deactivated tube connected the GC injector to the MS. Carrier gas (10 mL/min) was bubbled through ethanol. The saturated carrier gas continuously flowed through the 1st reactor. Additional helium (50 mL/min) was added as the vapors flowed from the 1st to the 2nd reactor. The temperature of the 1st reactor was held at 100ºC in order to prevent condensation in the reactor. The 2nd reactor temperature was programmed from 100ºC to 450ºC at 20 ºC/min) – see Fig. 2. The reaction products were monitored, real time.

[**Results**] As the temperature of the catalyst increases, the conversion of ethanol to ethylene is observed. Fig. 3 clearly shows that the concentration of ethylene and water increases as the catalyst temperature increases beyond 200ºC. Equilibrium conversion is reached when the catalyst temperature is greater than 320ºC. Reaction intermediates like diethyl ether (formed during the dehydration of ethanol) are observed at temperatures between 180 and 320ºC. This simple example illustrates how this system can quickly and easily be used to characterize the catalytic conversion of species A to products B. Using a mass spectrometer as a detector greatly simplifies the process of identifying conversion products.

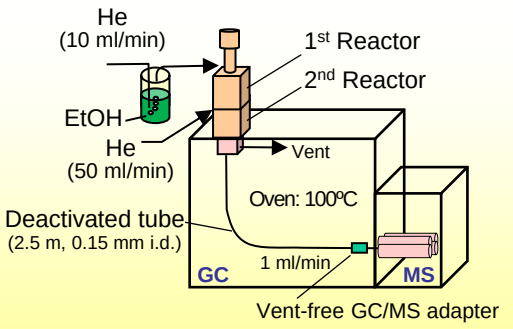

Fig. 1 Tandem μ-Reactor GC/MS system

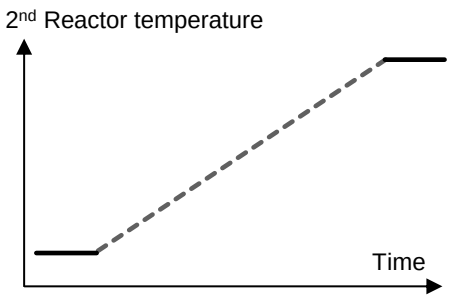

Fig. 2 Linear temperature mode

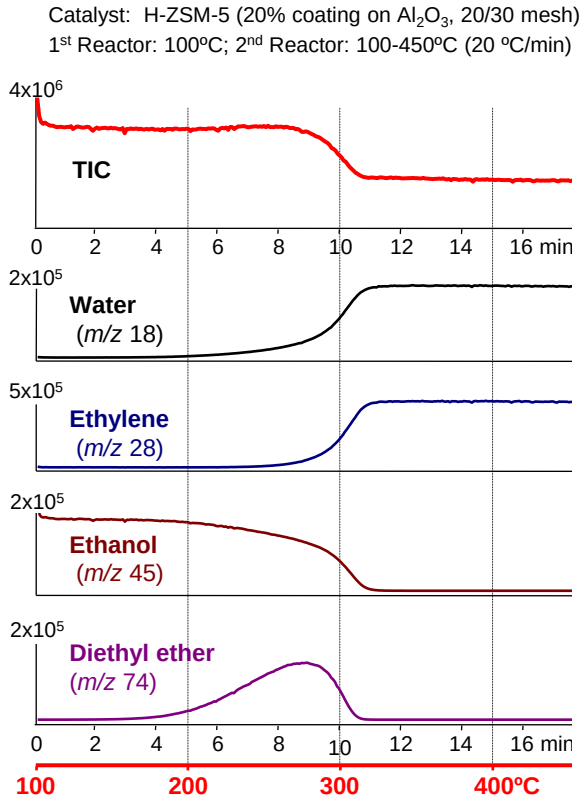

Fig. 3 On line analysis of catalytic reaction of ethanol vapor

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Keywords : Screening, evaluation, conversion of ethanol to ethylene

Products used : Tandem μ-Reactor, μ-Reactor, Selective Sampler, MicroJet Cryo-Trap, Vent-free GC/MS adapter, UA-1

Applications : Catalyst screening and evaluation

Related technical notes : RXT-001E, RXA-002E

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