Effect of pressure on catalytic conversion efficiency

- Catalytic reaction of glycerin with a Pd catalyst -

[Background] Comprehensive catalyst characterization requires an understanding of how factors such as reaction temperature and pressure impact the conversion efficiency and selectivity of the process. Technical note (RXT-002E), describes the medium pressure flow controller (MP-3050FC) that is used to control the reaction pressure (up to 1 MPa) of the μ-Reactor system; the effect of the reaction pressure on catalytic reactions can be directly examined. This report illustrates how reaction products change when the reaction is done at three different pressures.

[Experimental] A rapid catalyst screening system was used for the measurement. It consists of MP-3050FC and Tandem μ Reactor (Rx-3050TR) and is directly interfaced to a GC/MS system. 0.3 mg of glycerin was placed in a sample cup and introduced into the 1st Reactor heated at 300 ºC. Thermally decomposed products were reacted over a Pd/Al_2O_3 catalyst (ca. 10 mg) in a quartz reactor tube inside the 2nd Reactor heated at 300 ºC. The catalytic reactions were done at pressures of 0.2, 0.5 and 0.97 MPa. Hydrogen was used as a reaction gas and carrier gas. A MicroJet Cryo-Trap was used to temporarily trap the reaction products at the head of a separation column. Once the reaction was completed, the Cryo-Trap was turned off and allowed to warm, and the volatile products were separated and detected by GC/MS.

[Results] The chromatograms of the reaction products at 0.2 and 0.97 MPa are shown Fig.1. It can be easily seen that major products are ethane and propane. The plots of the peak areas of products versus reaction pressure are shown in Fig. 2. It is shown that the peak area of propane increased as the reaction pressure increased, while the peak areas of ethane, butane, pentane, and hexane decreased. This demonstrates that when the reaction pressures are varied, how the reaction products change can easily be observed using the rapid catalyst screening system.

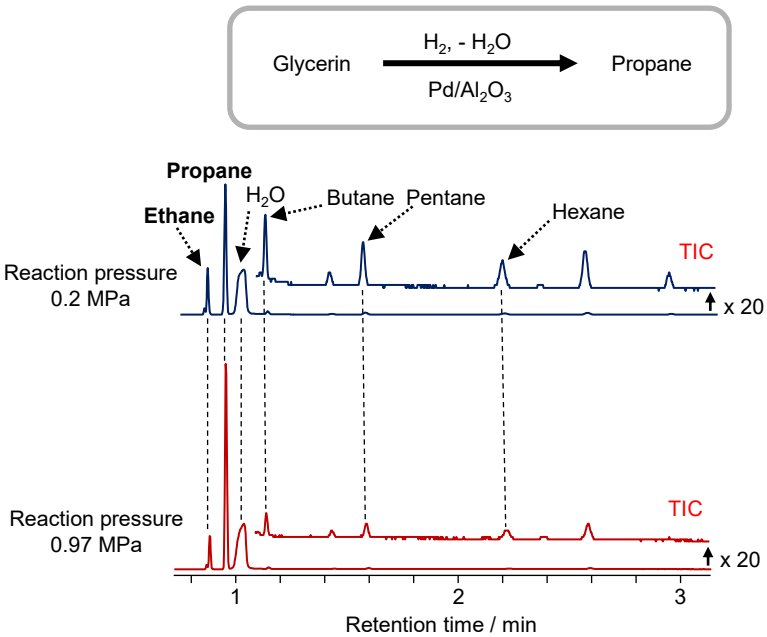

Fig. 1 Chromatograms of reaction products

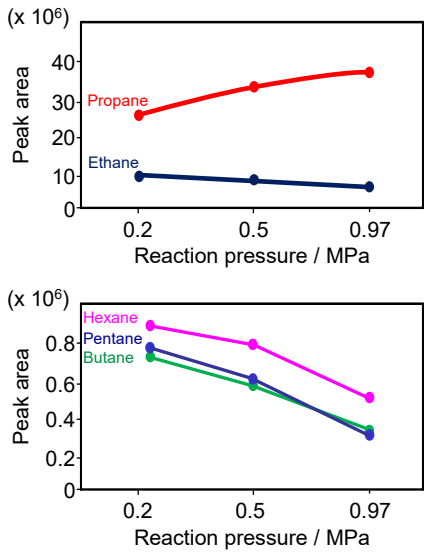

Fig. 2 Peak areas of products vs. reaction pressure

Reactor temp. (1st/2nd reactors): 300 ºC, Carrier gas: H_2 (80 kPa, constant pressure mode), Split ration: 1/100
Separation column: UA+-1(dimethyl polysiloxane) *L*=30 m, i.d.=0.25 mm, df=2 μm
Products cryo-trapped for 5 minutes with liquid nitrogen.
Catalyst: Pd/Al_2O_3 (10 mg), Sample: Glycerin (0.3 mg)

Keywords : Catalyst screening, Glycerin, Palladium catalyst

Products used : Tandem μ-Reactor, Medium pressure controller, MicroJet Cryo-Trap, UA+-1, Vent-free GC/MS adapter

Applications : Catalyst screening, Catalysis evaluation

Related technical notes : RXT-002E

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