Simulated CO2 Conversion Process GC Analysis

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Introduction:

Global CO2 emission reduction and neutralization become imperative in order to slow down global warming process and leave a livable earth to our next generations. Various controls are used to reduce CO2 level in our atmosphere. One of these CO2 controls is the carbon utilization technology to convert CO2 to other valuable and useful chemicals. Many genius Scientists and Engineers in the world are studying and developing CO2 conversion technology in race.

The CO2 conversion is well known as to ***Methanol*** from that other chemical reaction technique and sciences are being developed. The CO2 to Methanol reaction is described as the following well known steps.

$$CO_2 + H_2 = CO + H_2O \text{ (RWGS)} \quad (1)$$
$$CO_2 + 3H_2 = CH_3OH + H_2O \quad (2)$$
$$CO + 2H_2 = CH_3OH \quad (3)$$
$$nCH_3OH \rightarrow C_nH_{2n} + nH_2O \quad (4)$$

From these known the reactions, the process samples from reaction (2) contain CO2, H2, H2O and Methanol mixtures. Measurement each component will help to develop workable catalyst and reaction process. Gas Chromatography (GC) analysis can be used to produce fast and accurate measurements of CO2, methanol, along with level changes of H2 and H2O. Based on the measurement result, the reaction process can be dynamically tuned in order to complete the CO2 conversion reactions.

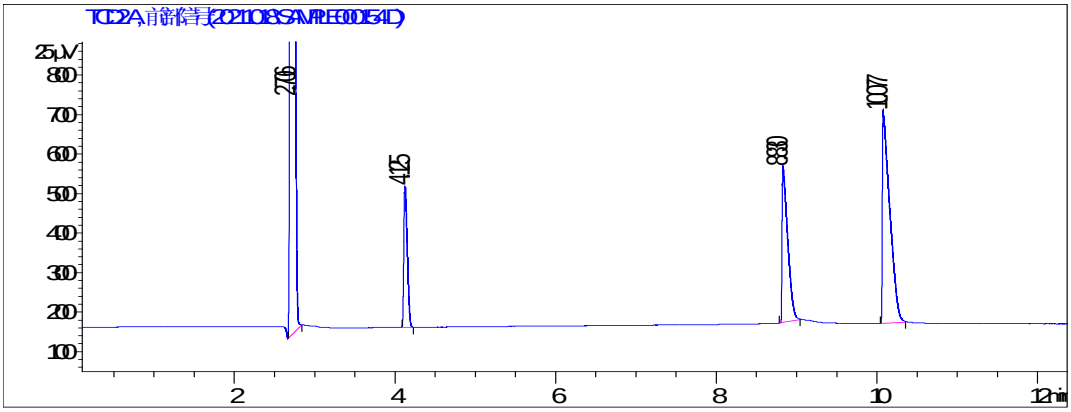
GS-Tek has developed a simple and easy vapor/steam-GC-TCD method at above ambient temperature for this CO2 analysis. This method produces baseline separations H2, CO2, H2O and methanol within 12min. This analysis approach can be easily and economically implemented in most CO2 research labs.

The result is reported in the following.

Instrument condition:

GC Instrument: 7890 GC with Split/Splitless cap Inlet and TCD
Column: 4753-3000, GsBP-CO2, 30m x 0.53mm
Carrier: Helium, 4ml/min constant flow mode
Oven: 50C (3min) 20C/min to 150C (8min)
Inlet: 180C, split flow 30:1
Detector: TCD, 200C, reference gas flow 10ml/min (Helium), make up 5ml/min (Helium)
Sample: 0.3cc house made CO2, H2O, Methanol vapor blended with H2, manual injection

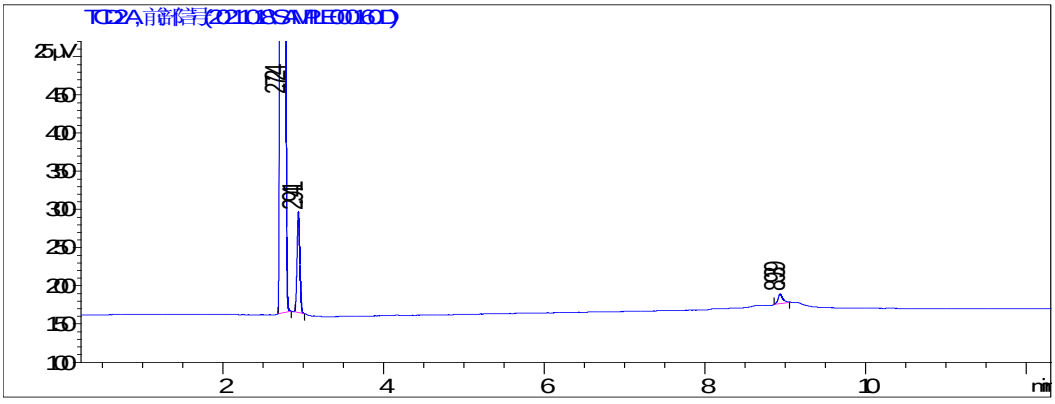
Chromatogram of Reaction (2):



Peak Identifications:

Retention time (min)	Peak	peak area percentage
2.706	H2	76.7%
4.125	CO2	3.5%
8.83	H2O	7.1%
10.077	MeOH	12.7%

Chromatogram of Reaction (4)



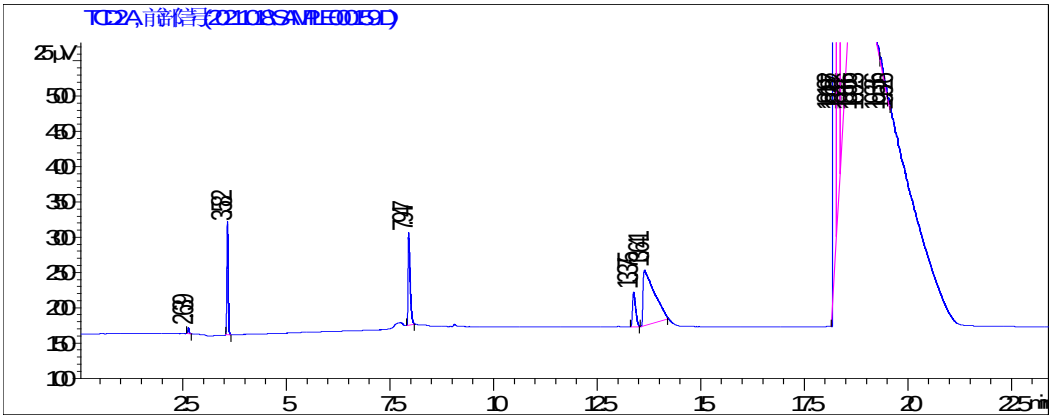
Peak Identifications:

Retention Time (min)	Peak Name
2.724	H2/N2
2.941	***Methane***
8.939	H2O

Chromatogram of a CO2 conversion to Acetic acid

Instrument condition:

GC Instrument: 7890 GC with S/Sl Inlet and TCD
Column: 4753-3000, GsBP-CO2, 30m x 0.53mm
Carrier: Helium, 4ml/min constant flow mode
Oven: 65C (3min) 20C/min to 175C (15min)
Inlet: 180C, split flow 30:1
Detector: TCD, 200C, reference gas flow 10ml/min (Helium), make up 5ml/min (Helium)
Sample: 2ul acetic acid with blended H2, H2O, and CO2, manual injection



Retention Time (min)	Peak Name
2.639	air/H2
3.582	CO2
7.947	H2O
13.375	impurity
13.641	impurity
18.191	acetic acid

Summary:

GS-Tek reports a simple vapor/stream-GC-TCD analysis of CO2 reactant samples for a few CO2 conversion processes. This analysis can be optimized further for analysis time and sampling techniques. It can also be extended to other CO2 conversions like acetic acid mentioned in this note.

For Inquiries of this analysis, instrument configuration or sampling technique, please contact:

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