Activities of Asian cooperative research on food and agricultural wastes

EcoTopia Science Institute
Nagoya University

Tatsuya Hasegawa

Center for Interdisciplinary Studies on Resource Recovery and Refinery in Asia

EcoTopia Science Institute

- Established in July 2007

Missions of CIS3RA

- Research on **Resources Recycling** in Asia
  - Energy Resources
  - Material Resources
- **Formation of Network** in Asia
  - International Information Hub
  - Human Resource Development

Center for Interdisciplinary Studies on Resource Recovery and Refinery in Asia

EcoTopia Science Institute, Nagoya University

Institutions of Asian countries
- China
- Korea
- Indonesia
- ASEAN
- India etc.

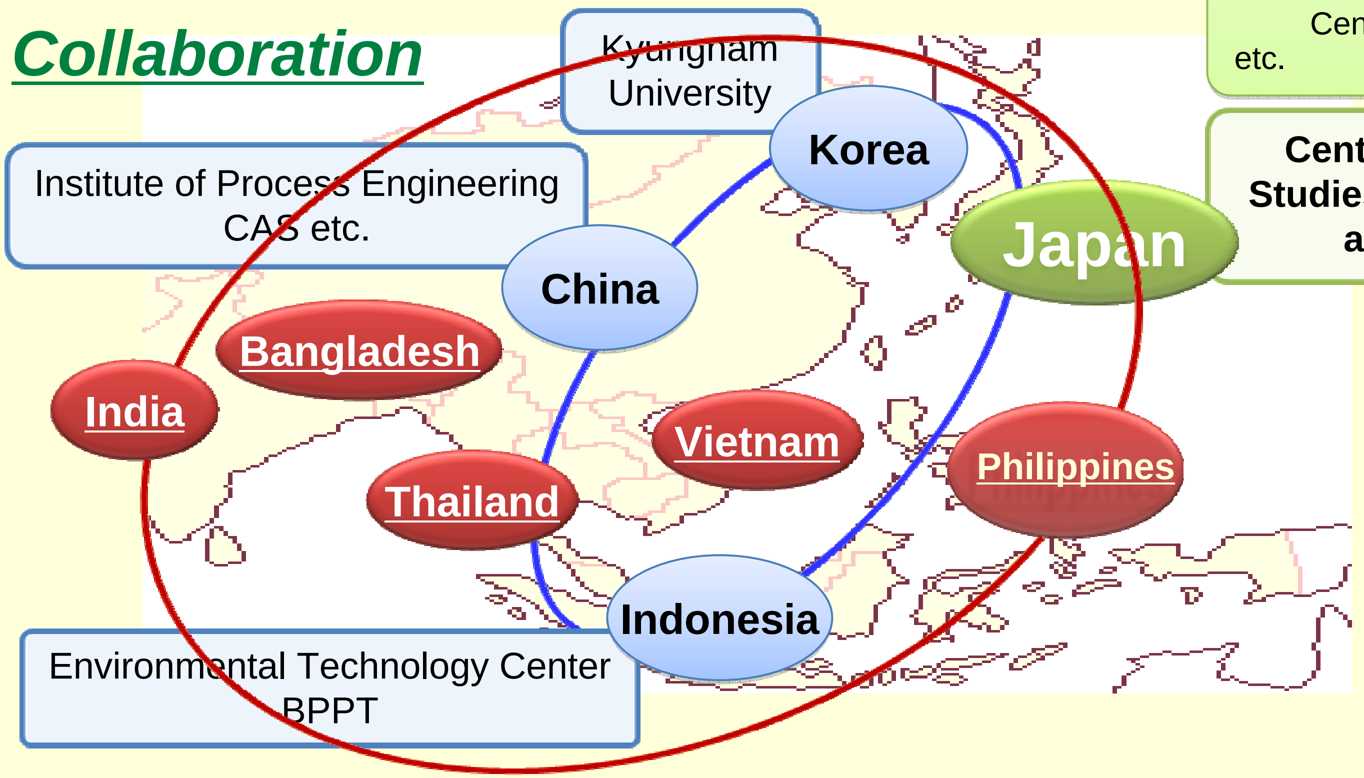
Research
- Recovery of Energy and Material Resources

Network
- Research Information
- Education, Training

Nagoya University
- EcoTopia Science Institute
- Graduate School of Engineering
- Graduate School of Environmental Studies
- Graduate School of Bioagricultural Sciences
  International Cooperation Center for Agricultural Education
- Graduate School of Economics
  Economic Research Center
- Graduate School of Law
  Center for Asian Legal Exchange

etc.

Collaboration



Center for Interdisciplinary Studies on Resource Recovery and Refinery in Asia

Expanding Network to Asian and Other Countries

Organization

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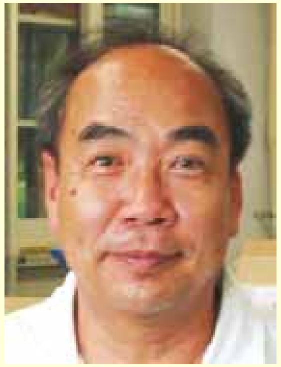

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Research Project

- **Extracting Resources from Biowates by Refinery Technology**
- **Among Japan, China, Korea, Indonesia**
- **Supported by MEXT (2006-2008)**

Refinery technology = Cascade utilization

1. Extraction of **chemicals** from wastes
2. Conversion to gas/liquid **fuels** from wastes
3. Conversion to **thermal energy** from wastes
4. Social & Economic **Assessment**

Key technology: hydrothermal process

(water at 200-500 ^{o}C and 15-30 MPa)

Some topics of research on food and agricultural wastes

Extraction of Bioactive Materials from Rice Hulls

Seung-Cheol Lee

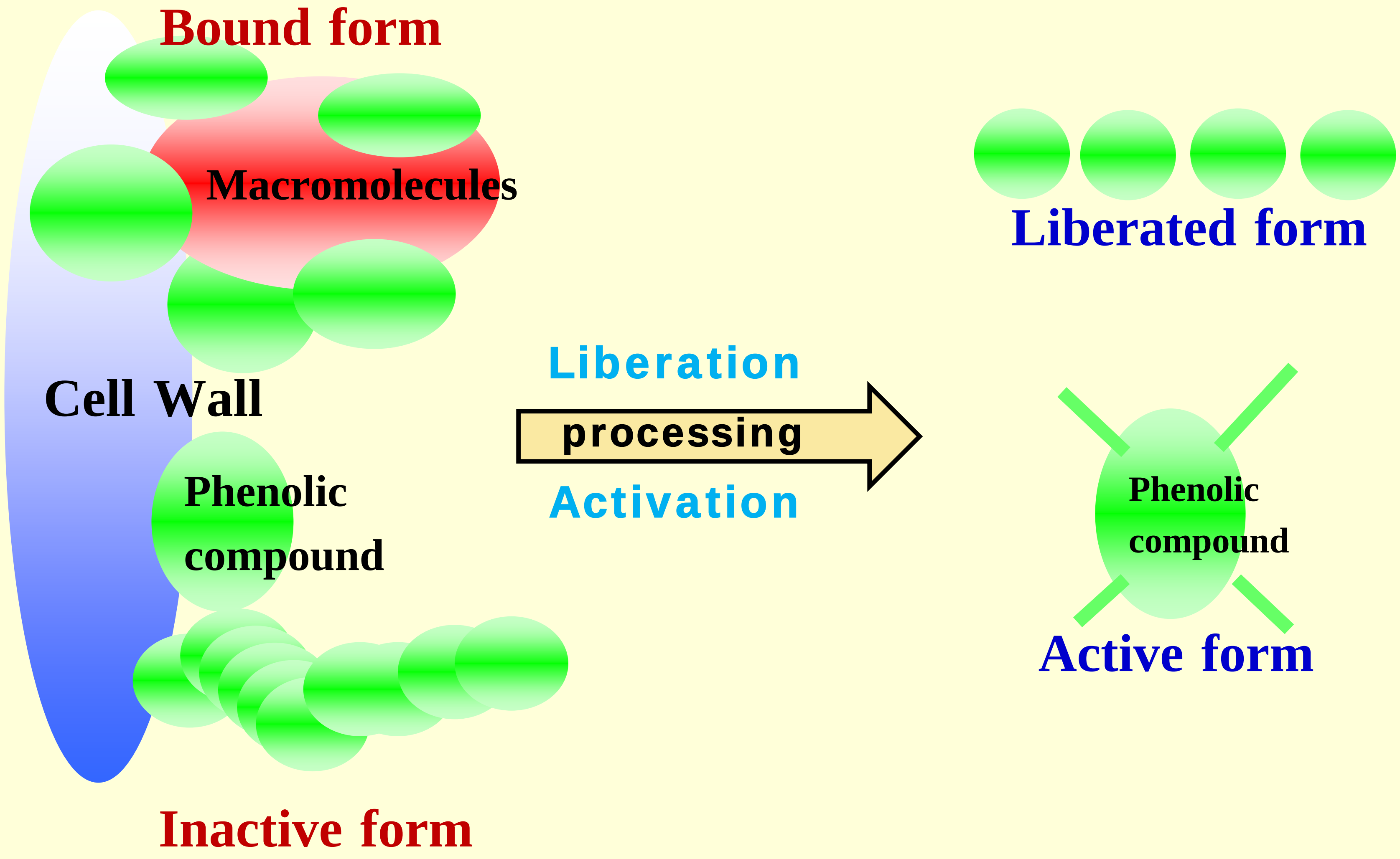
Department of Food Science and Biotechnology,
Kyungnam University, Korea

Rice Hulls

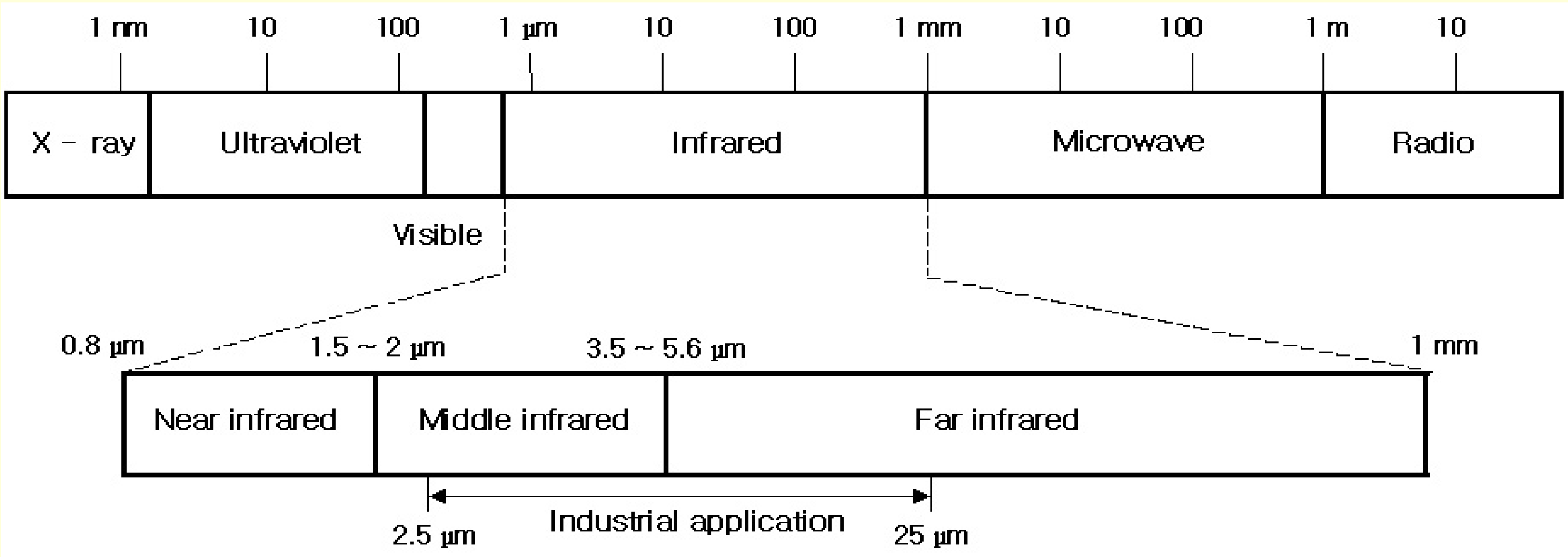
Rice hulls after processing of rice (20 % of rice grain)

Biowaste

Some Processing Methods

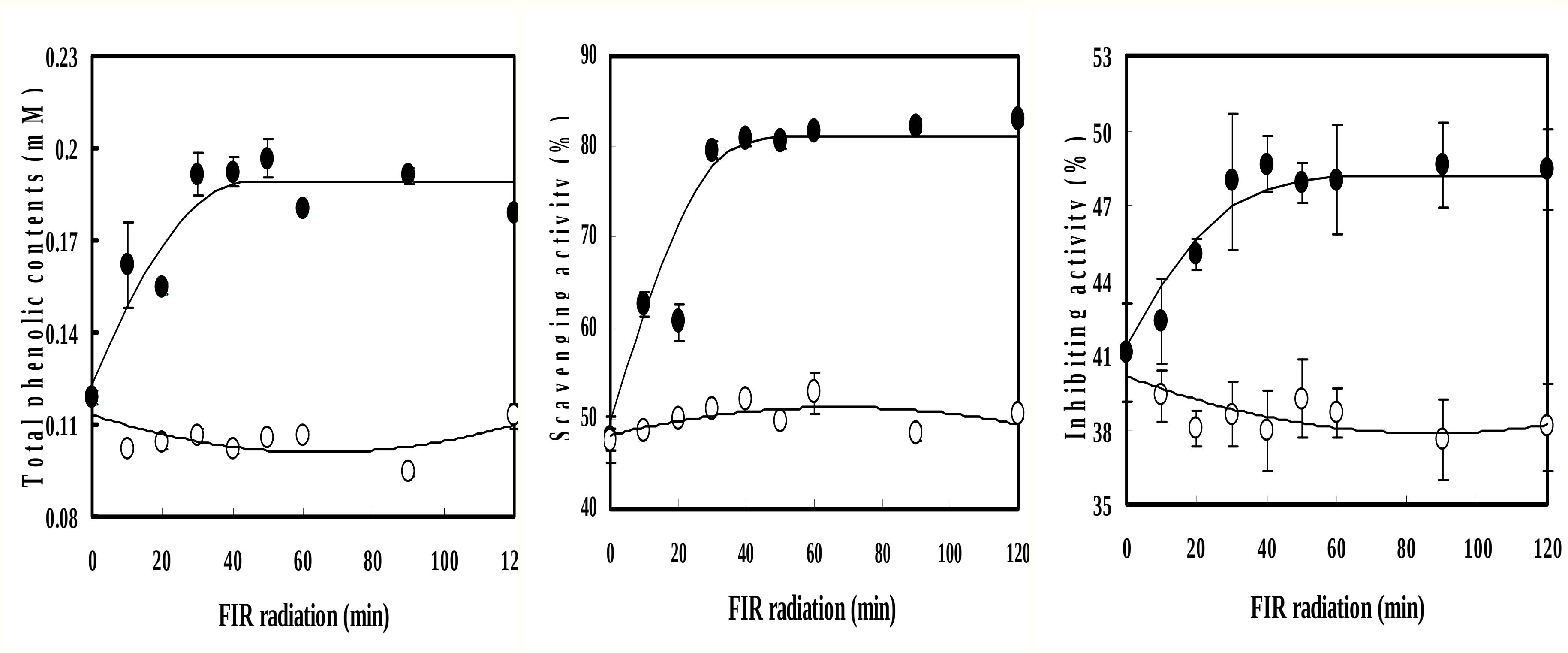


Far-Infrared Radiation



wavelength near 10 μm

Antioxidant Activities



Effect of FIR treatment on (A) total phenolic contents, (B) DPPH radical scavenging activity, and (C) lipid peroxidation of rice hull extracts. Symbols (●) indicate irradiated with FIR, and (○) dried at 100°C instead of FIR-radiation.

SubCW Extraction

14 cm

Rice hulls(RHs) (0.6 g) + Water (6 mL)

↓

Extraction Temperature

(25, 100, 150, 200, 250, 300, and 350 °C)

Extraction Time

(10, 30, and 60 min)

↓

Assay for antioxidant activity

Total Phenolic Contents

(Unit: μM)

Temp. (℃)	Reaction time (min)		
	10	30	60
25	165.1^{cz}	180.7^{bx}	210.1^{ax}
100	197.6^{by}	228.3^{av}	229.5^{aw}
150	210.8^{bx}	227.0^{av}	235.8^{av}
200	245.2^{bu}	248.3^{bu}	**270.2**^{au}
250	220.1^{aw}	211.4^{cw}	215.1^{bx}
300	228.3^{bv}	230.2^{bv}	228.3^{aw}
350	219.5^{bw}	220.1^{bv}	225.1^{aw}

Radical Scavenging Activity

(Unit: %)

Temp. (℃)	Reaction time (min)		
	10	30	60
25	8.40^{by}	10.73^{ax}	11.10^{ay}
100	14.37^{cx}	19.60^{bw}	23.53^{ax}
150	30.40^{cw}	49.57^{bu}	58.63^{au}
200	64.60^{ct}	67.10^{bt}	**79.33**^{at}
250	51.50^{bu}	43.91^{av}	43.59^{av}
300	41.99^{bv}	45.19^{av}	45.41^{av}
350	42.95^{av}	42.74^{av}	40.17^{bw}

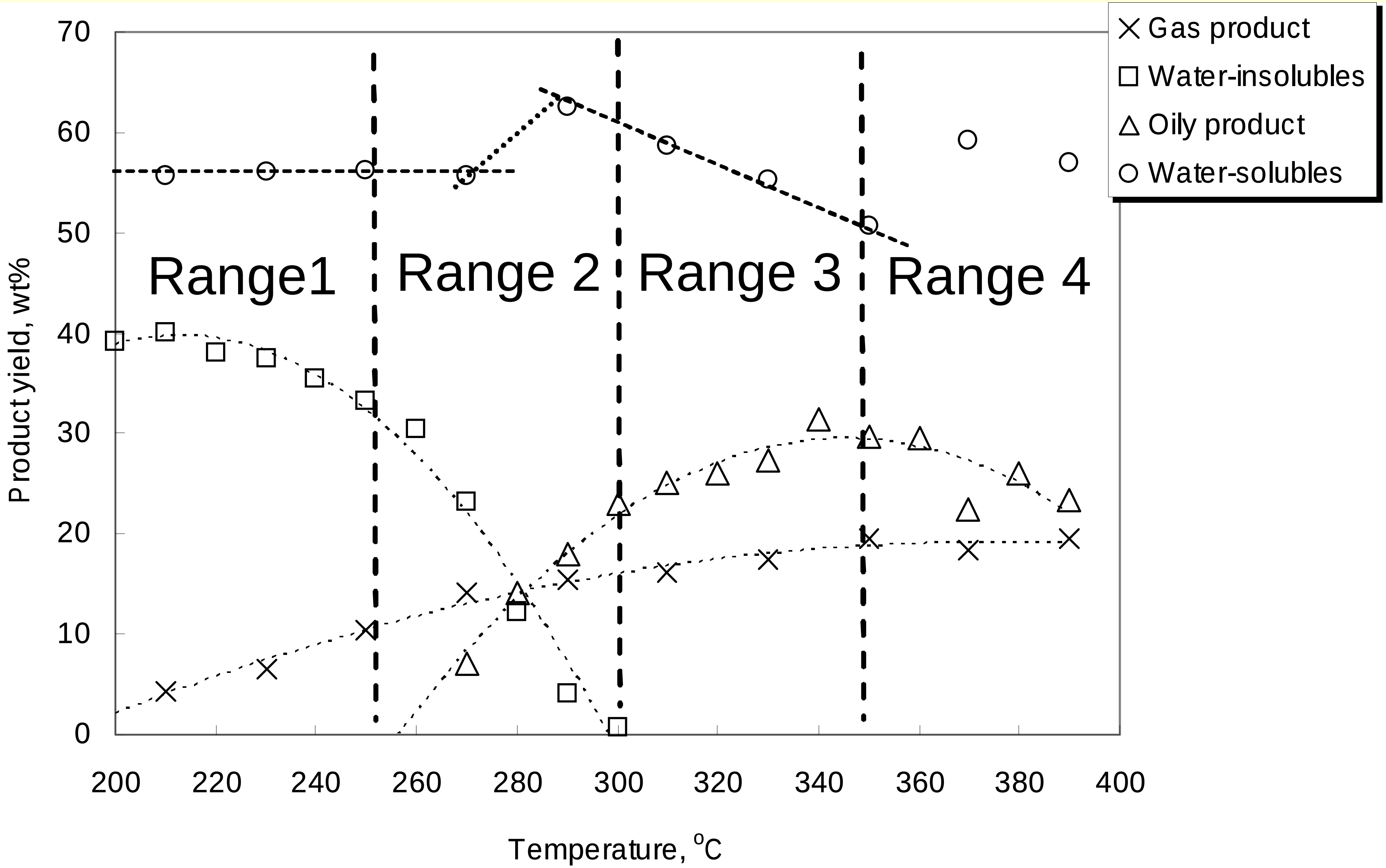
Hydrothermal behavior of tofu waste in hot compressed water

Yajun TIAN

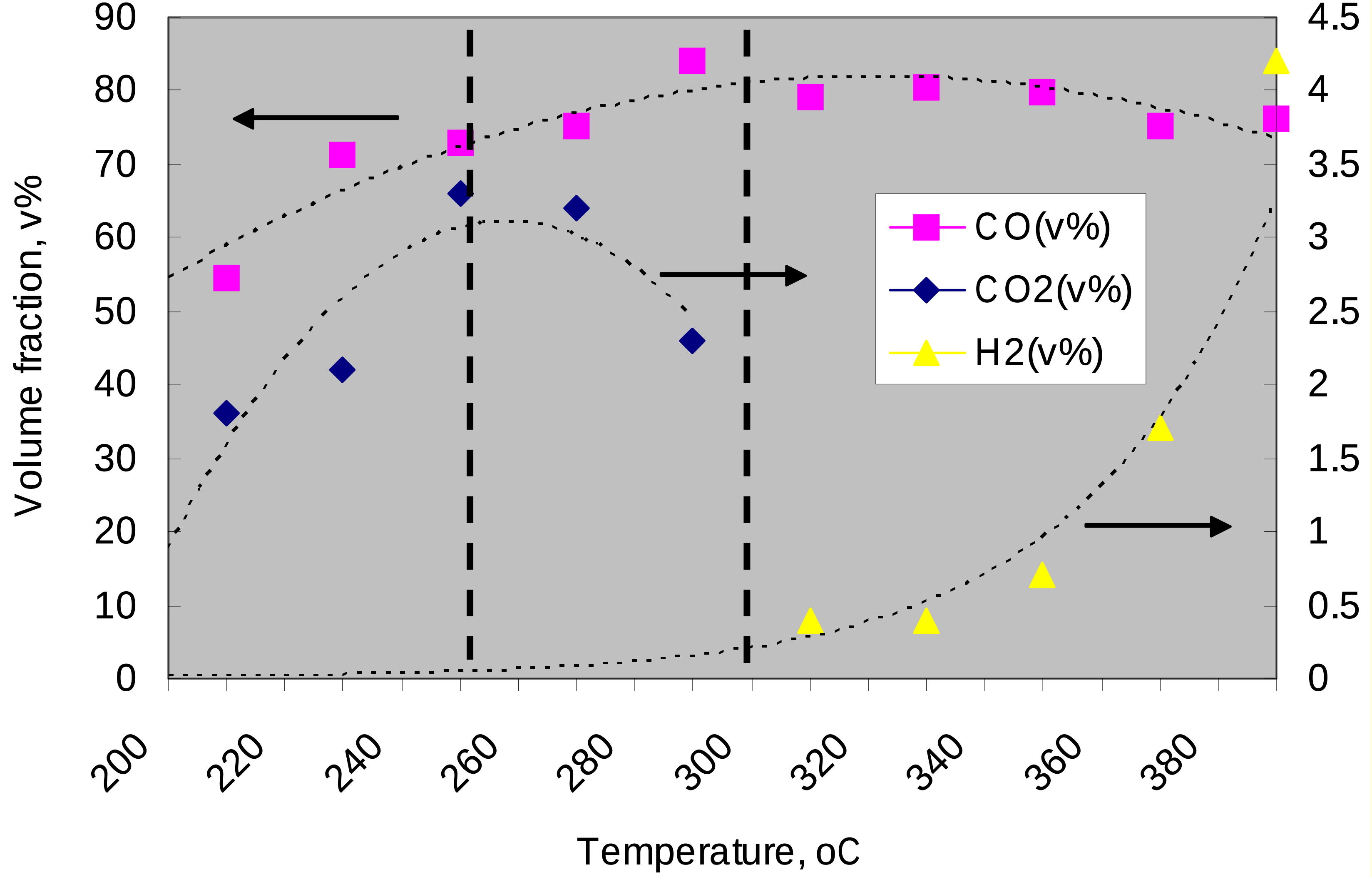
Kazuhiro KUMABE, Kozo MATSUMOTO, Hisae TAKEUCHI, Yusheng XIE, Tatsuya HASEGAWA

Nagoya University, Japan &
Institute of Process Engineering, CAS, China

Profiles of product yield evolution



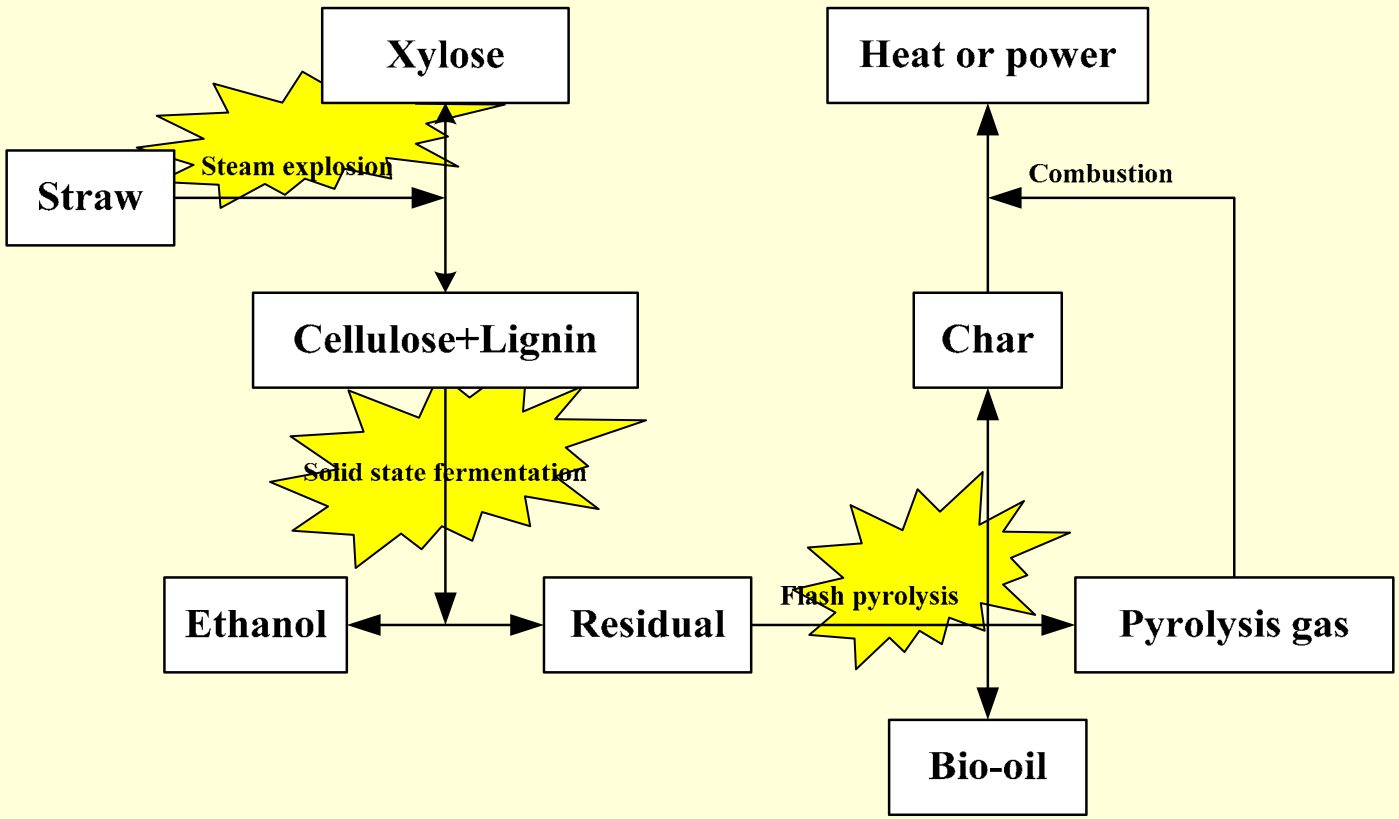
Gas composition evolution



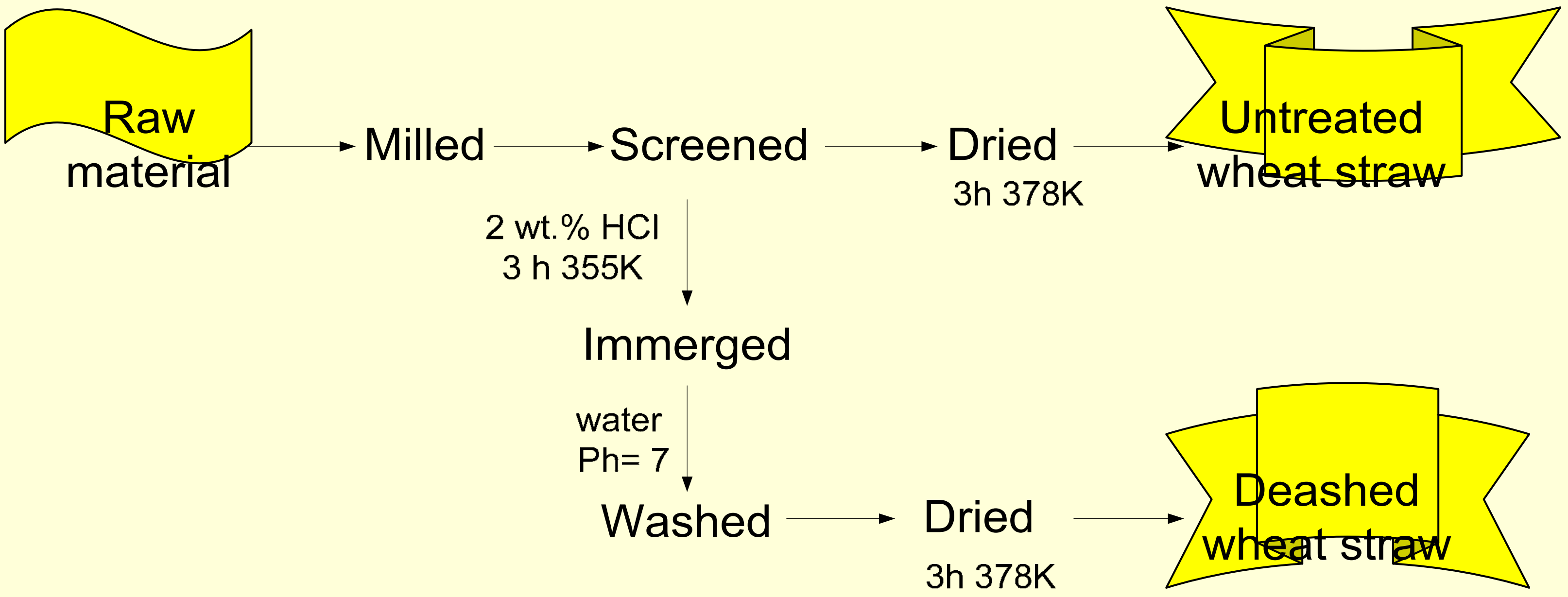
Bio-oil Production by Fast Pyrolysis of Deashed Wheat Straw in A Downer Reactor

- **Xuemin YANG**
- **Tongli DING, Jianjun XIE, Jianzhong YAO,**
- **Weigang LIN and Yusheng XIE**
- **State key laboratory of multi-phase complex system**
- **Institute of Process Engineering**
- **Chinese Academy of Sciences, P. R. China**

Scheme of bio- and thermal-conversion hybrid process of biomass developed at IPE, CAS, China



Process of wheat straw de-ashed treatment



3 Experimental apparatus

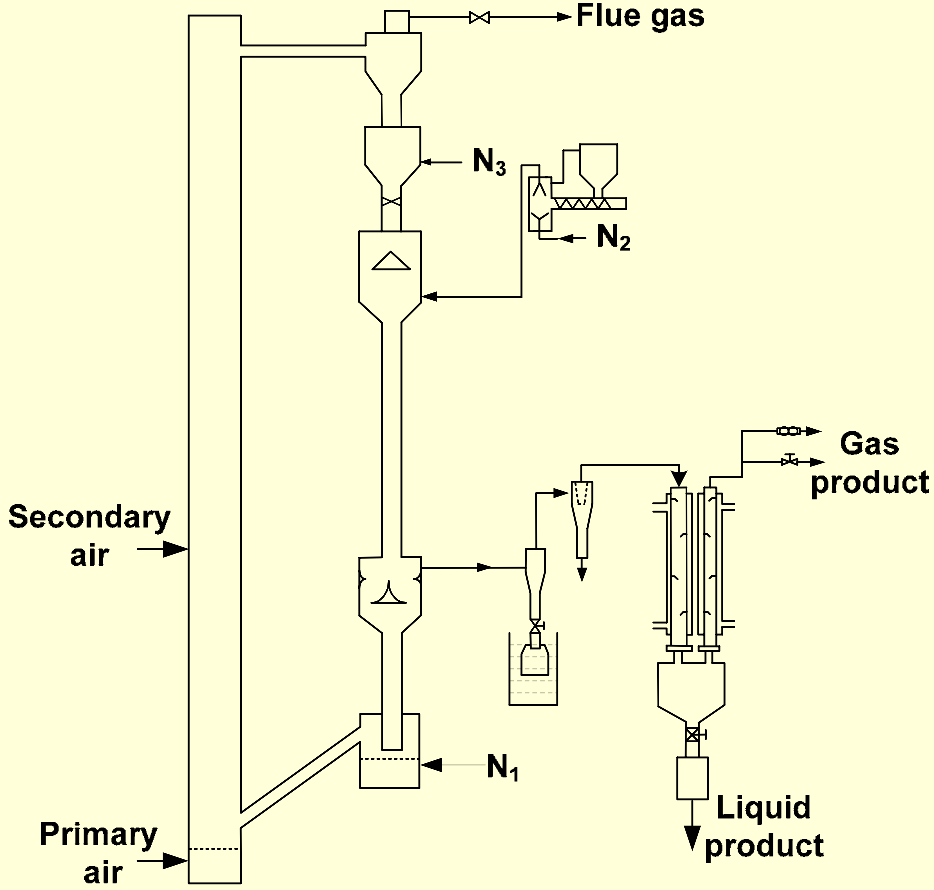


Fig.2 Schematic illustration of experimental apparatus
(a 30kW CFB reactor integrated with a riser and a downer)

Table 1 Chemical composition of untreated and de-ashed wheat straw

Composition		Wheat straw (wt. %)	De-ashed wheat straw (wt. %)
Proximate Analysis (%)	Moisture	1.49	4.09
	Ash	7.7	6.70
	Volatile Matter	74.39	83.78
	Fixed carbon	16.41	5.43
Ultimate Analysis (%)	C	43.41	44.38
	H	5.37	5.61
	N	1.09	5.42
	O	50.13	45.99
Chemical compositions (%)	Cellulose	32.9	44.8
	Hemicellulose	37.8	33
	Lignin	8.5	13.8
	Ash+others	20.7	8.3

Fig.4 Effect of pyrolysis temperature on char yields for wheat straw and de-ashed wheat straw

- **Yields of char**

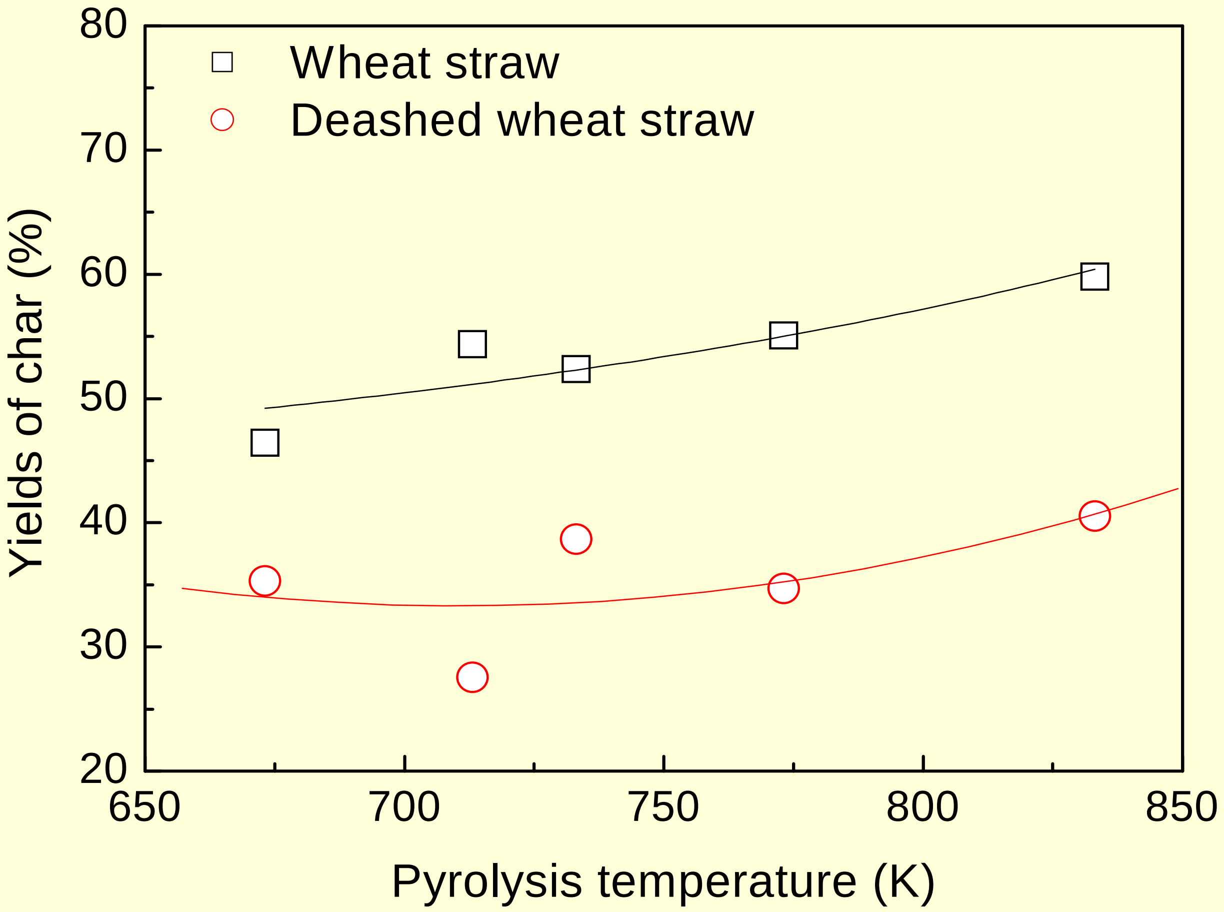
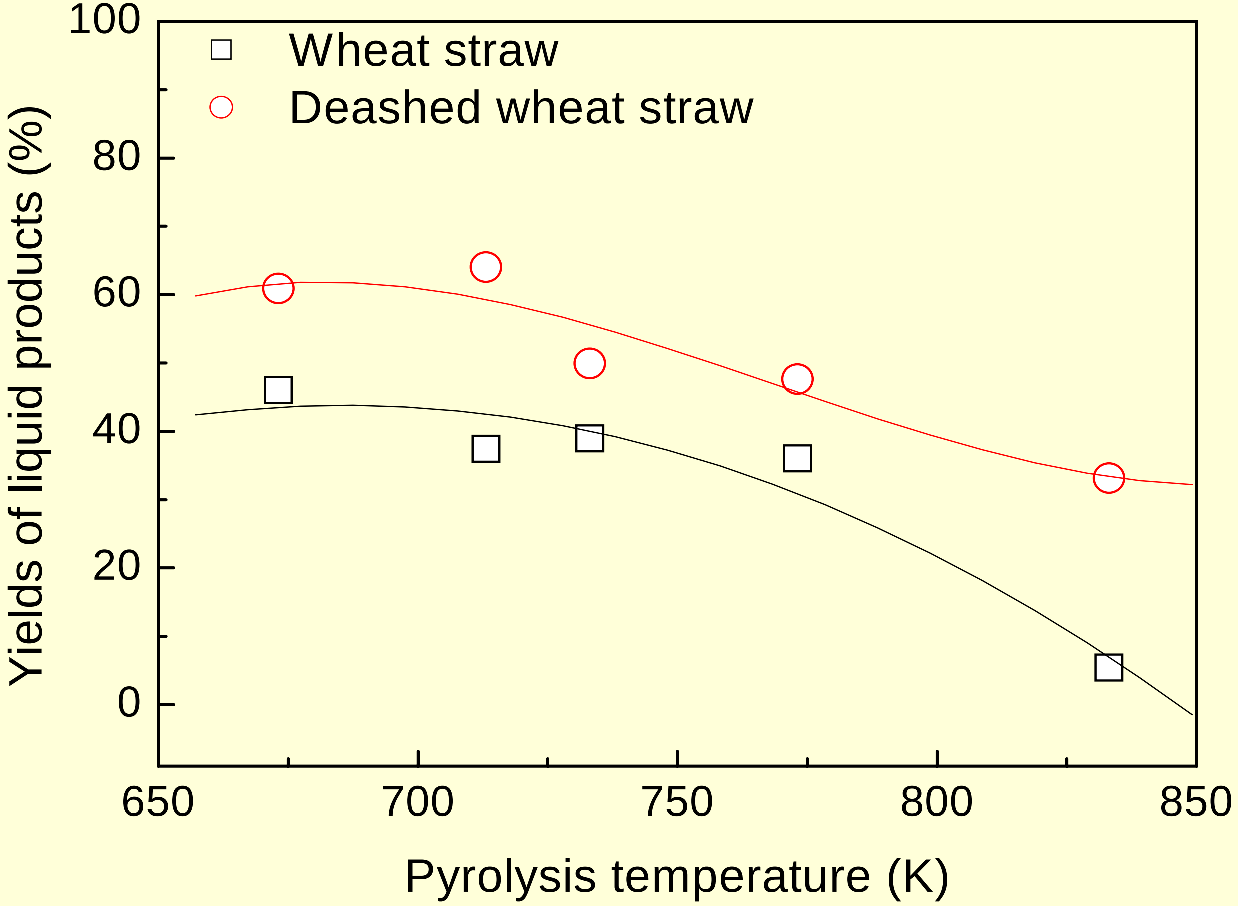


Fig.5 Effect of pyrolysis temperature on yields of liquid products for wheat straw and deashed wheat straw

- **Yields of bio-oil**



Effective and selective hydrogen formation from biomass through hydrothermal reaction

Yasuyuki ISHIDA, Tatsuya HASEGAWA, Kuniyuki KITAGAWA

EcoTopia Science Institute, Nagoya University

Samples

- Cellulose (Model biomass sample)

C: 44.4 wt% H: 6.2 wt%

- Real biomass

Wasted wood

C: 46.1 wt% H: 6.1 wt%
N: 1.5wt% S: 0.7 wt%

Sledges

C: 34.8 wt% H: 5.3 wt%
N: 7.6 wt% S: 1.3 wt%

"Okara" (Pulp separated from soybean milk)

C:46.2 wt% H: 6.7 wt%
N: 6.1 wt% S: 0.9 wt%

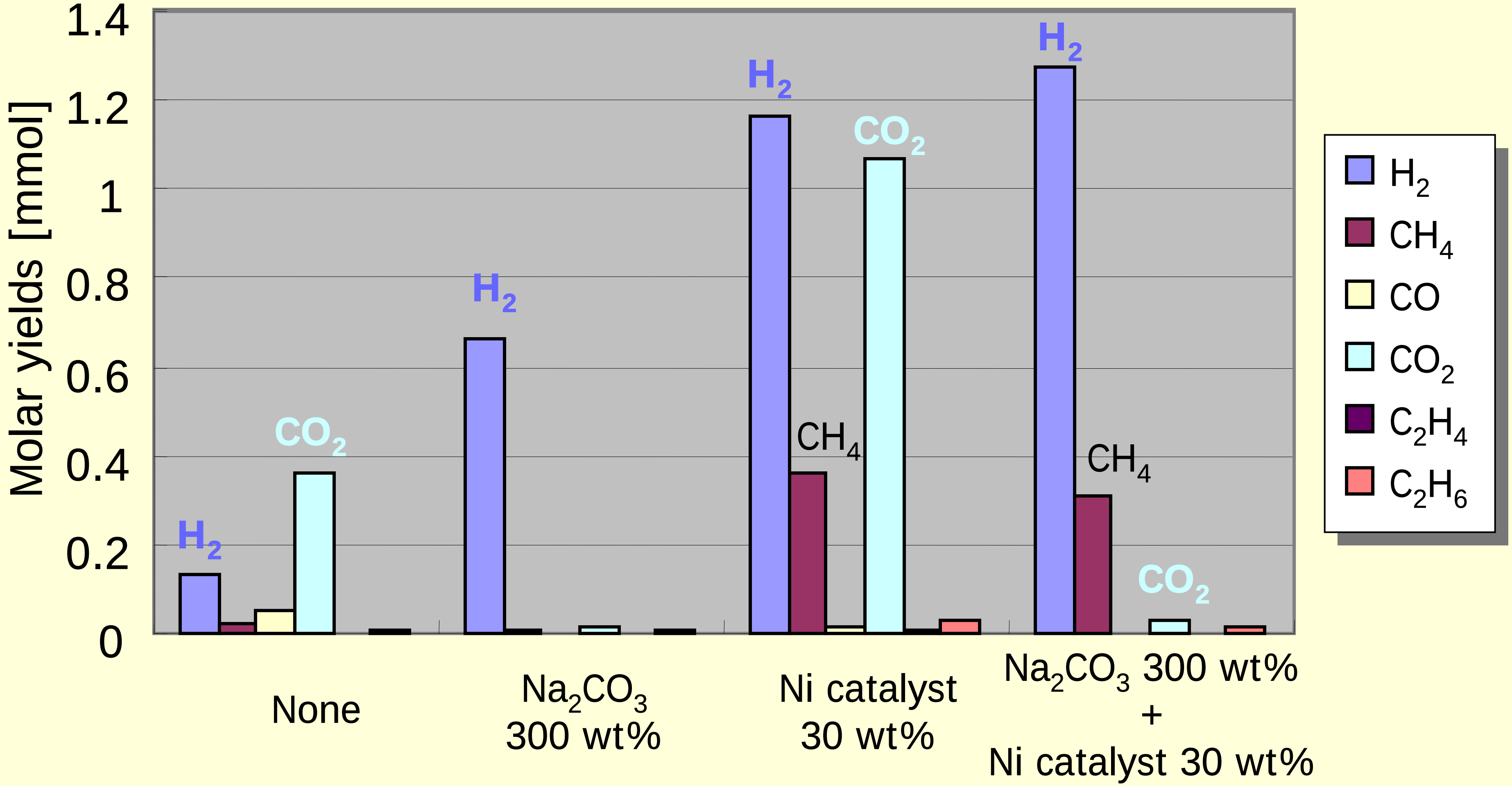
Hydrothermal Process (1)

- Biomass sample : 0.1 g
- Distilled water : 3 ml
- Additives :
  - Sodium carbonate (Na_2CO_3)
  - Nickel catalyst (Ni / SiO_2)
- Reaction Temp. : 400 ^oC
- Pressure : ca. 25 MPa

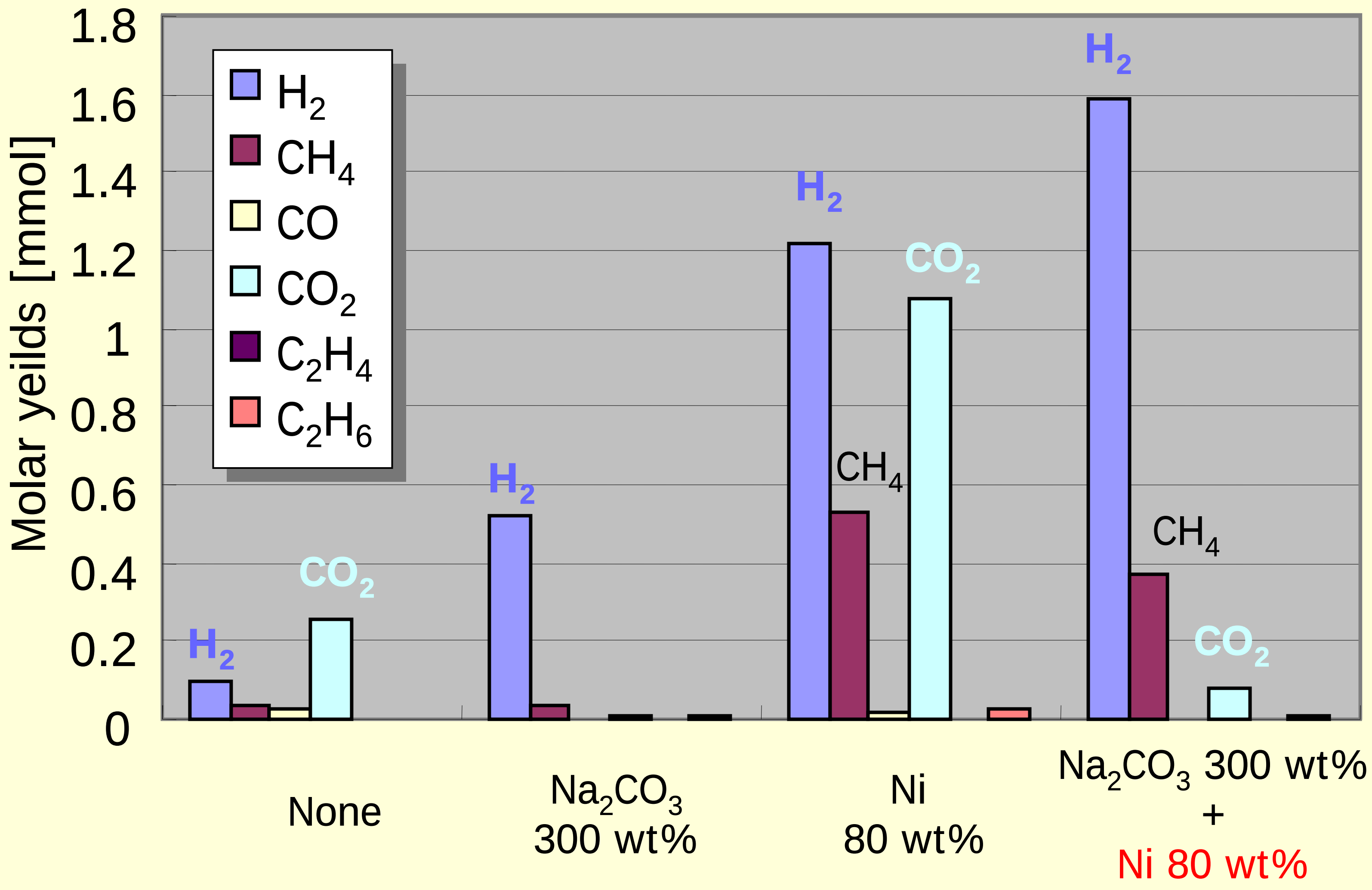
Microtube reactor
(10.5 ml)

Additive effect of Na_2CO_3 and Ni catalyst on hydrothermal reaction of cellulose

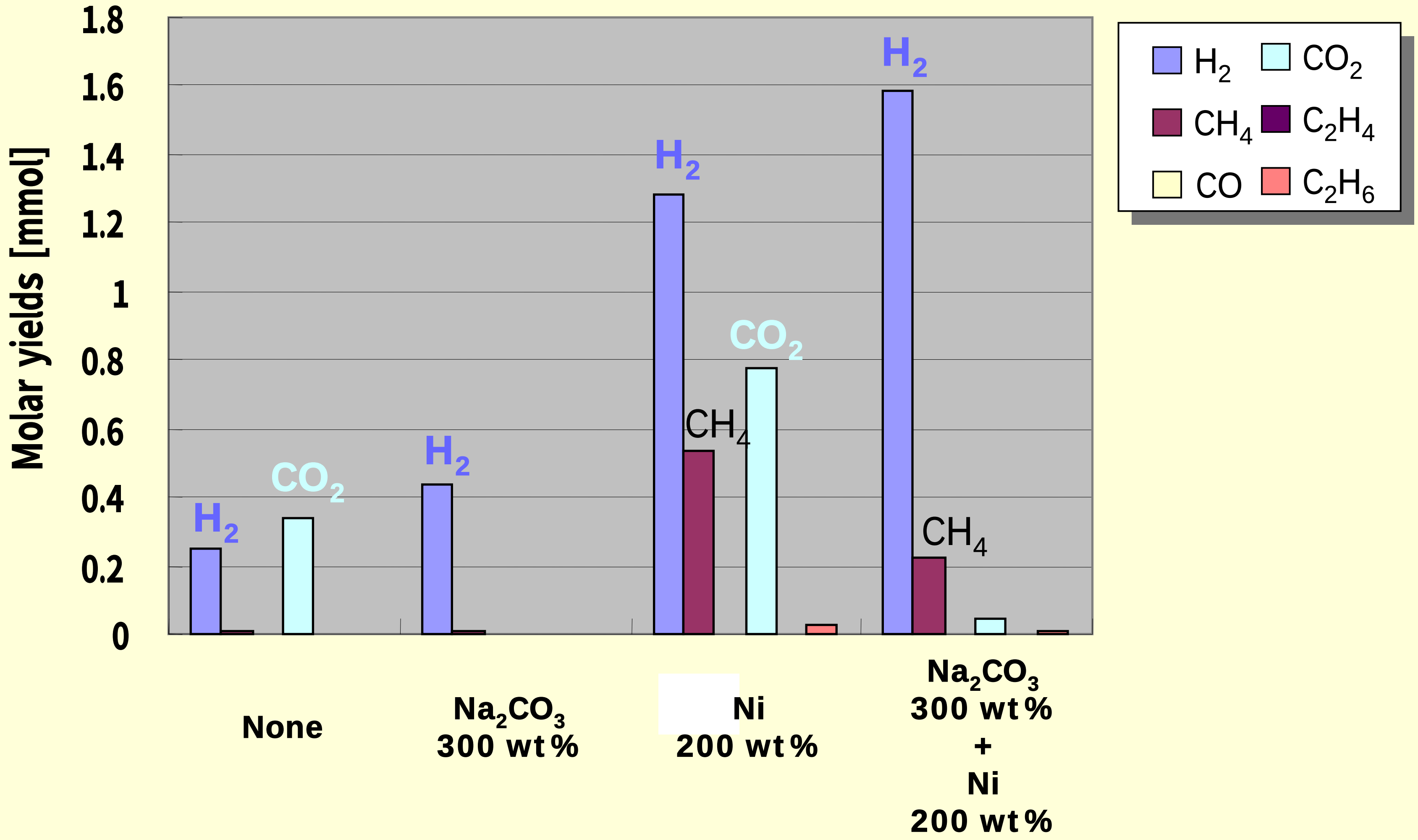
hydrogen conversion rate ≈ 90%



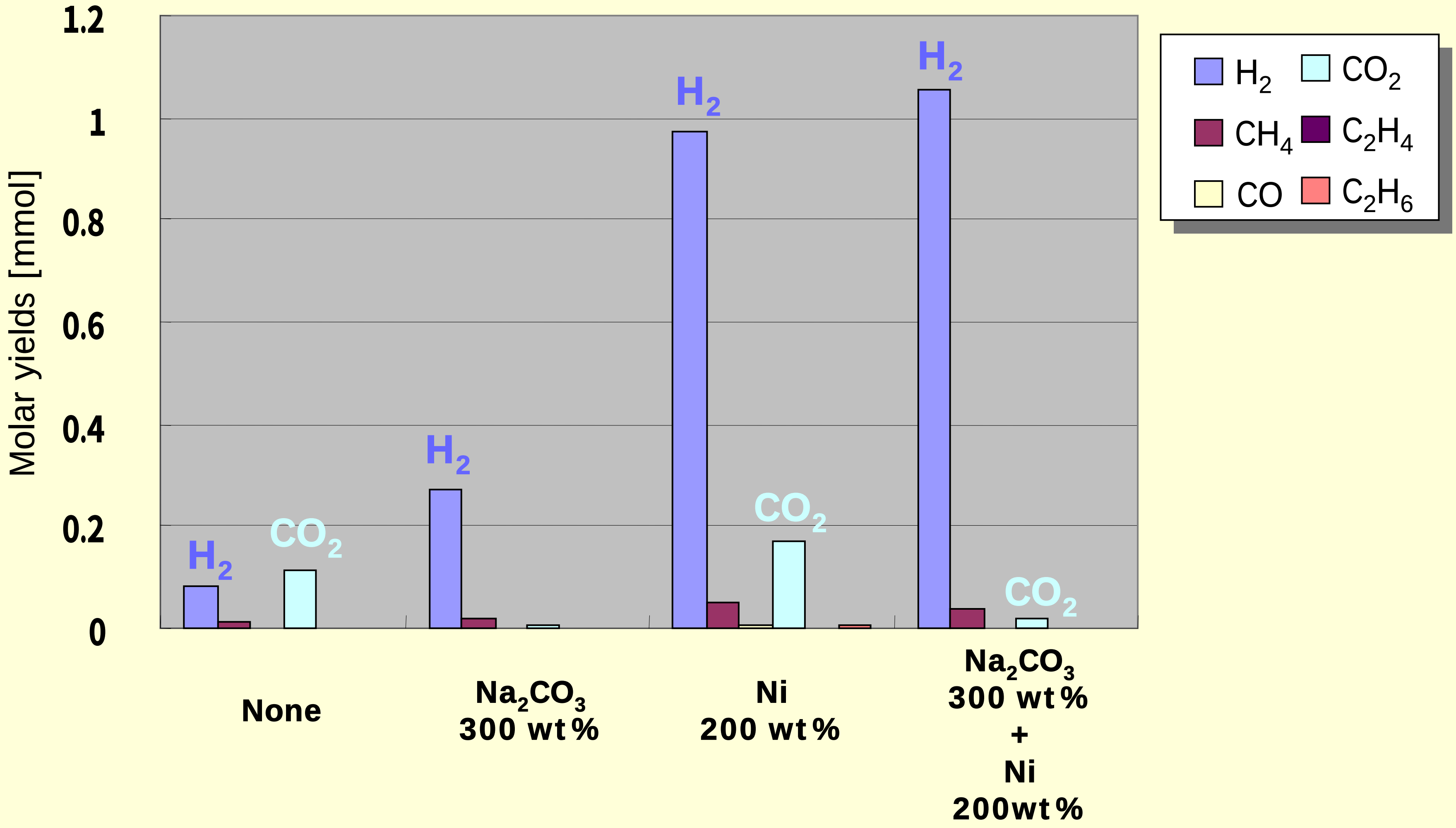
Hydrothermal reaction of wasted wood in the presence of Na_2CO_3 and Ni catalyst



Use of combination of the two additives for “okara” gasification



Use of combination of the two additives for sledges gasification



Thanks for your attentions