A close-up photograph of a microscope's objective lens and eyepiece. The lens is focused on a small, square microchip mounted on a glass slide. A bright green laser spot is directed at the center of the chip. The background is dark, making the metallic parts of the microscope and the illuminated chip stand out.

COE-INES International Symposium, INES-1
Keio Plaza Hotel

***Continuous Flow Chemical Processing on
a Microchip Using Microunit Operations
and a Multiphase Flow Network***

Manabu Tokeshi¹ and Takehiko Kitamori^{1,2}

¹Kanagawa Academy of Science & Technology

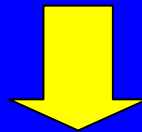
²The University of Tokyo

Table of Contents

1. Background, Objective and Our Approach
 - Micro unit operations (MUOs)*
 - Multiphase flow network*
 - Continuous flow chemical processing (CFCP)*
2. Co wet analysis using CFCP
3. 3D CFCP (Ex. Fe & Co analysis)
4. Summary

How to realize “Chemical Processing” on a Chip ?

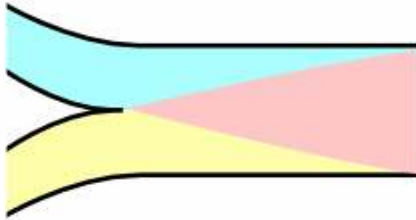
- Micro unit operations (MUO)
- Multiphase flow network



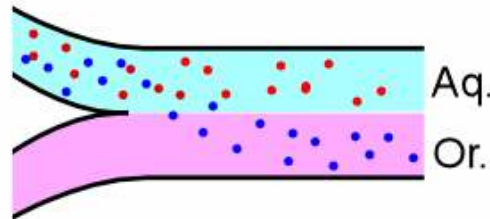
Continuous Flow Chemical Processing (CFCP)

Micro Unit Operation (MUO)

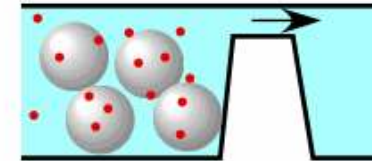
Mixing & Reaction



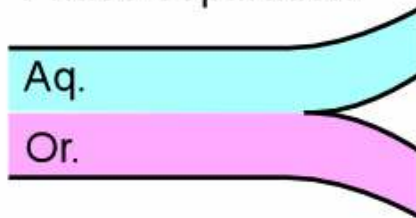
Molecular transport
Solvent extraction



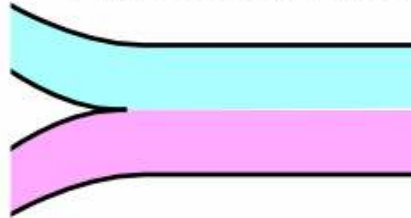
Molecular capture
Solid extraction



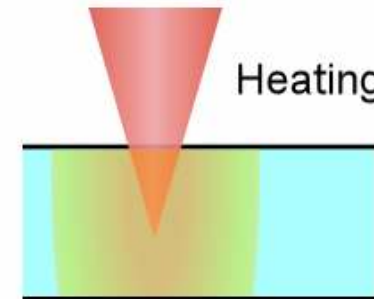
Phase separation



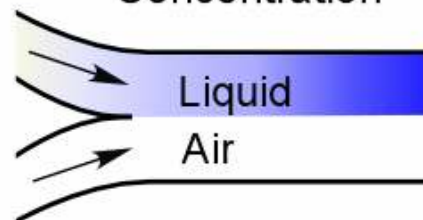
Phase confluence



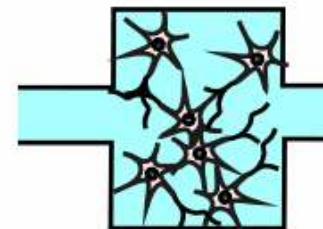
Heating



Concentration

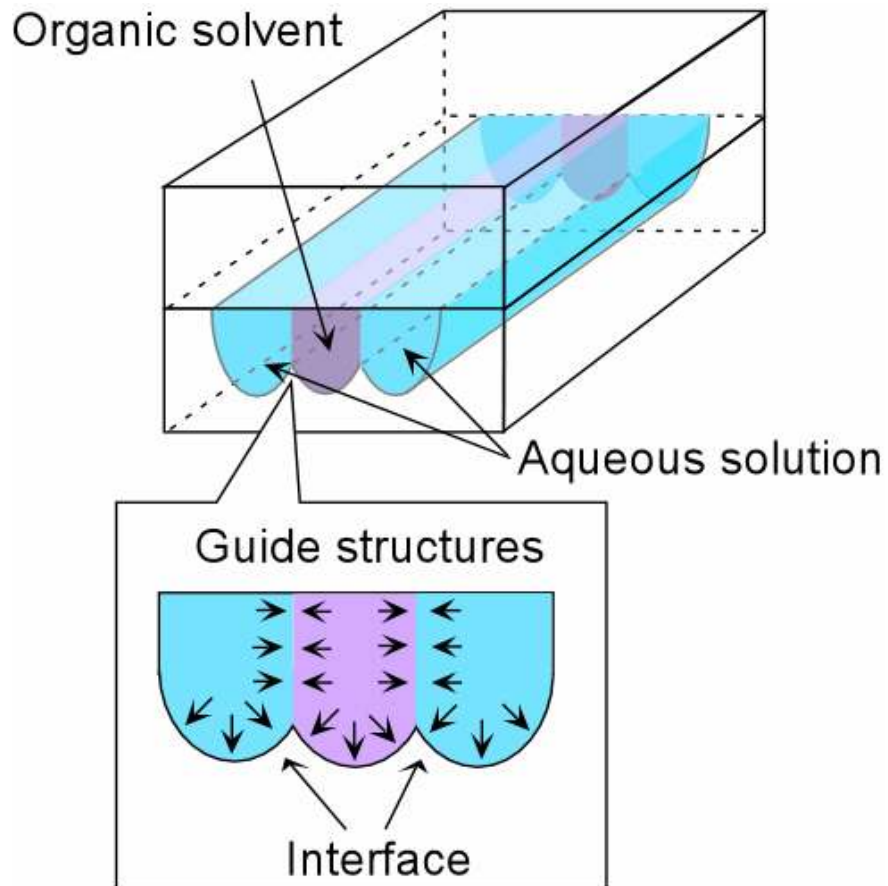


Cell culture

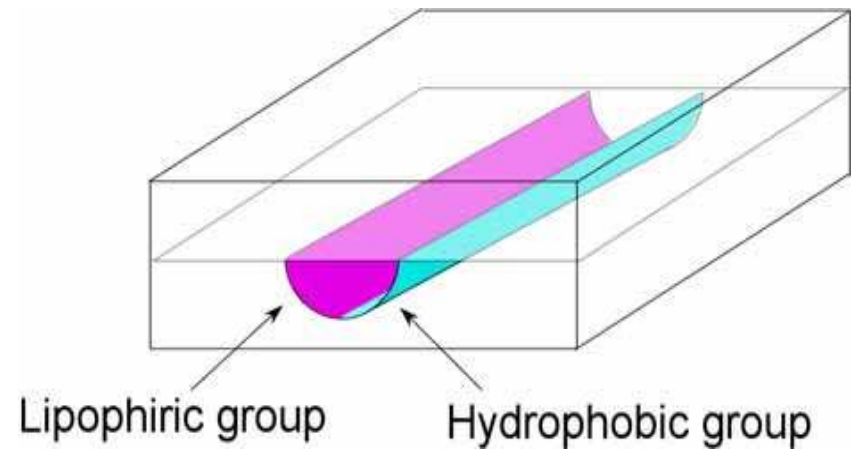


Stabilization of Multiphase Flow Network Inside Microchannels

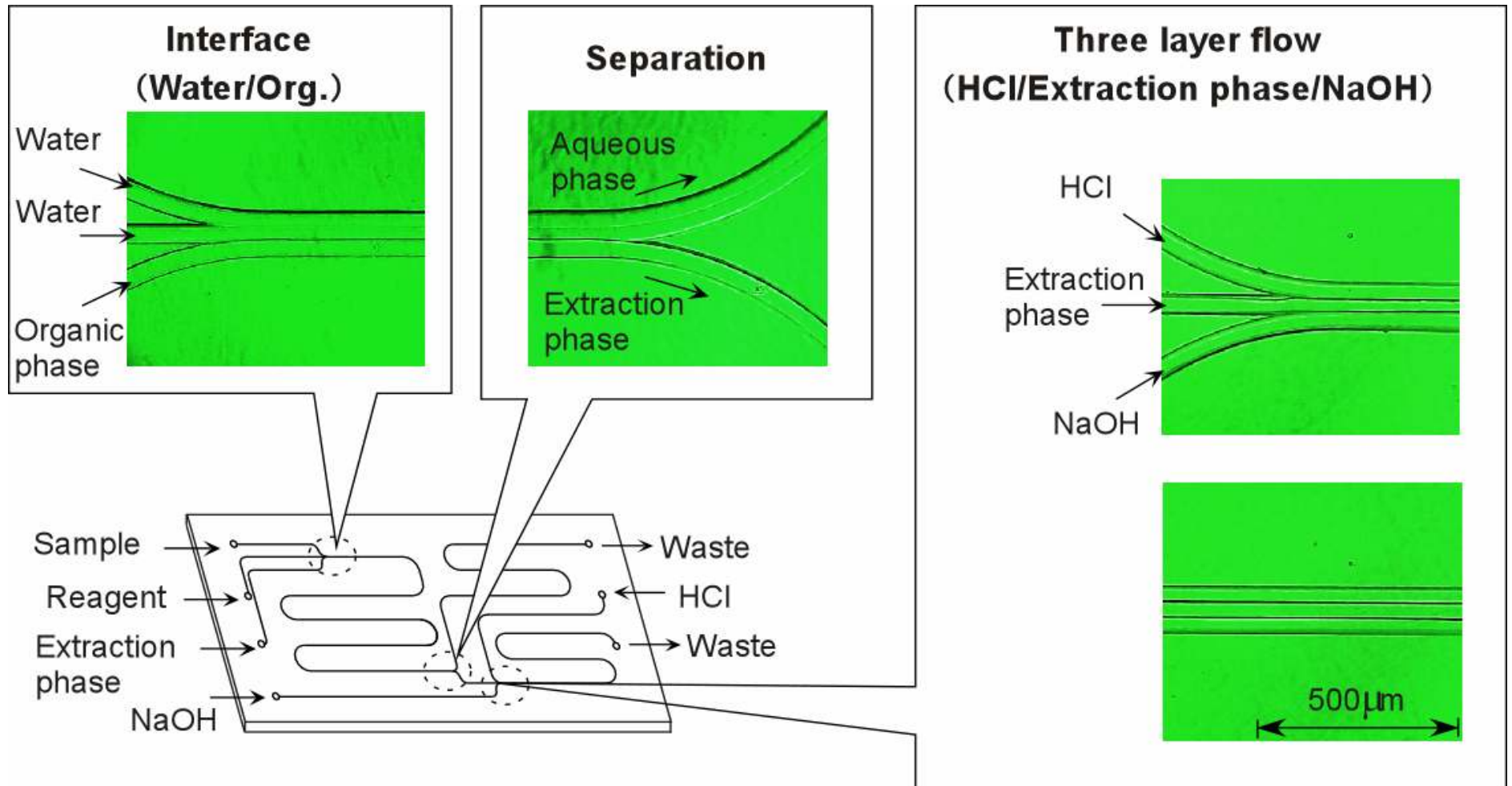
Guide structures



Surface modification



Multiphase Flow Network

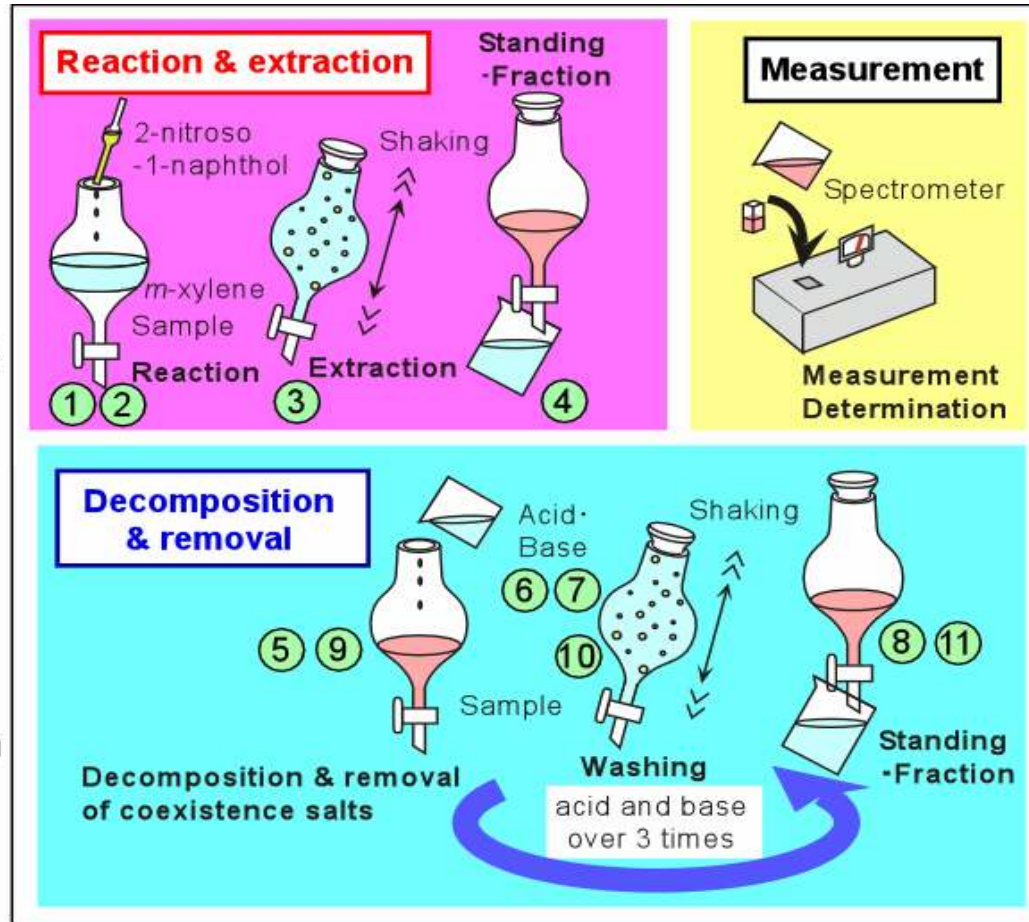


Example of Co wet analysis using CFCP



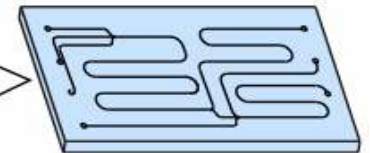
Procedures of Co Wet Analysis

- ① Mixing · Reaction
- ② Confluence
- ③ Extraction
- ④ Phase separation
- ⑤ Confluence
- ⑥ Decomposition
- ⑦ Extraction
- ⑧ Phase separation
- ⑨ Confluence
- ⑩ Removal
- ⑪ Phase separation



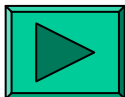
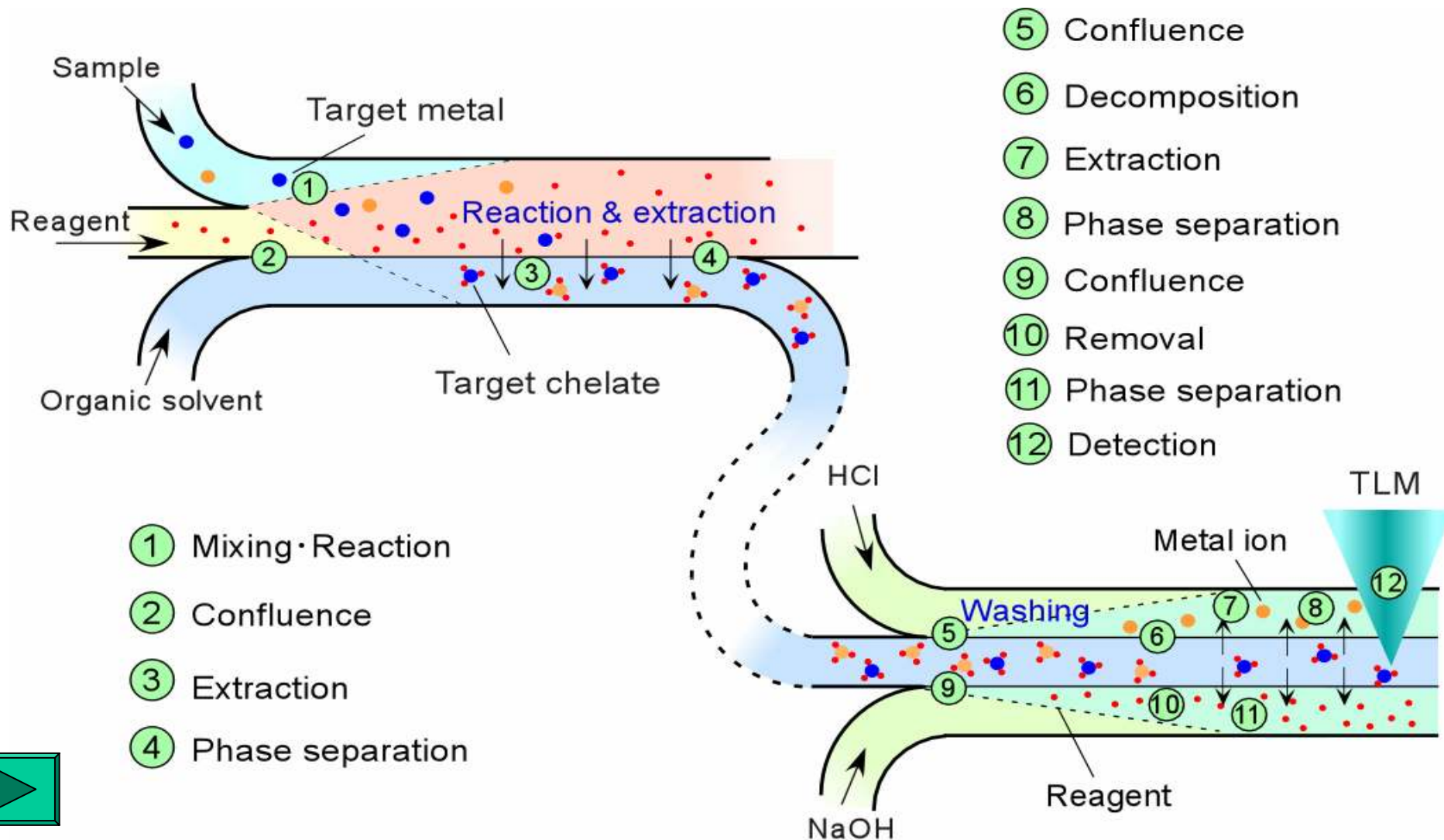
⑫ Detection

Same functions

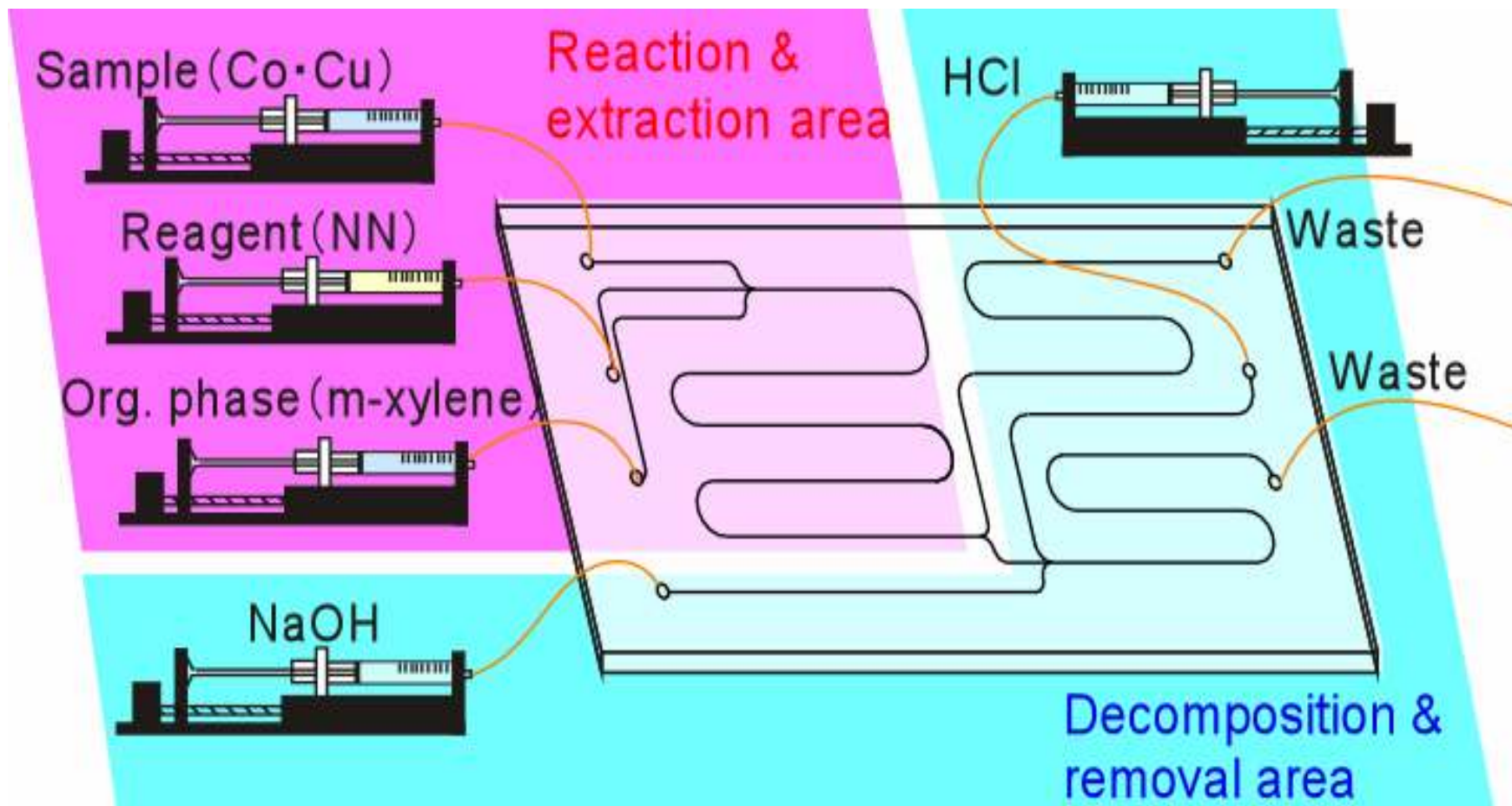


Integration

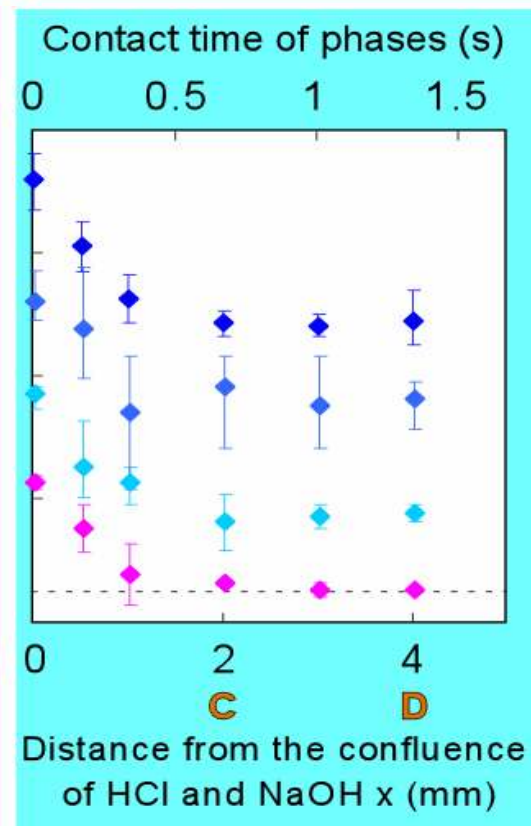
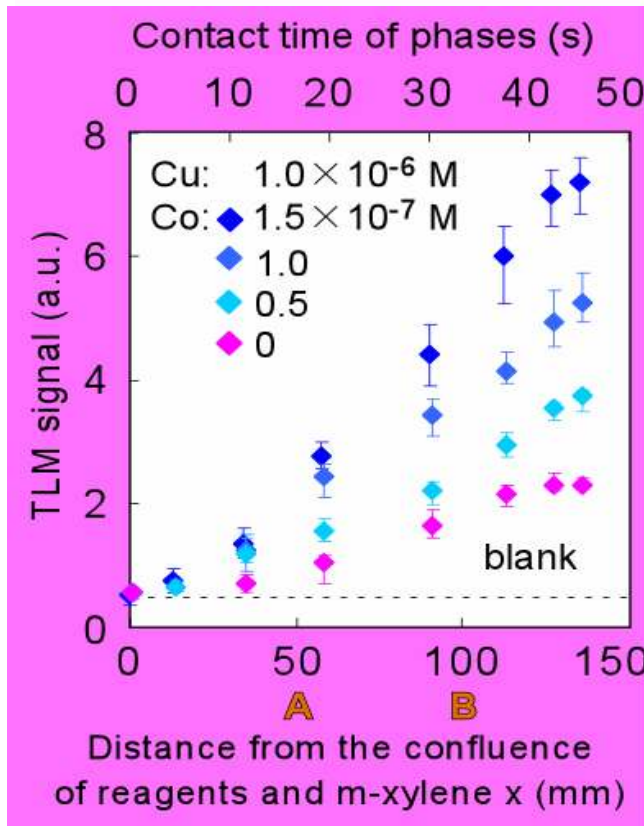
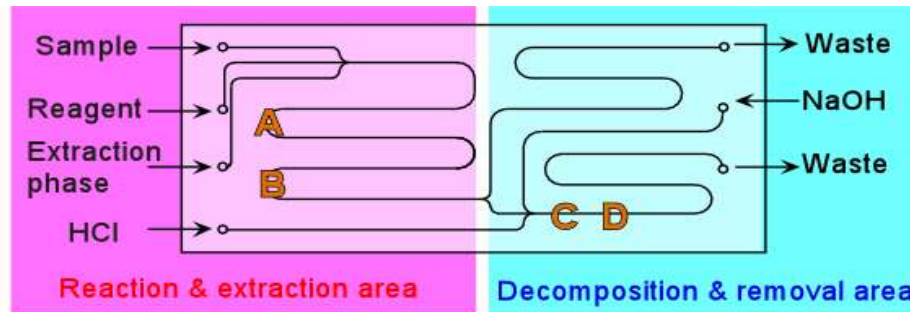
Combination of Micro Unit Operations required for Co Wet Analysis



Microchip and Experimental Setup

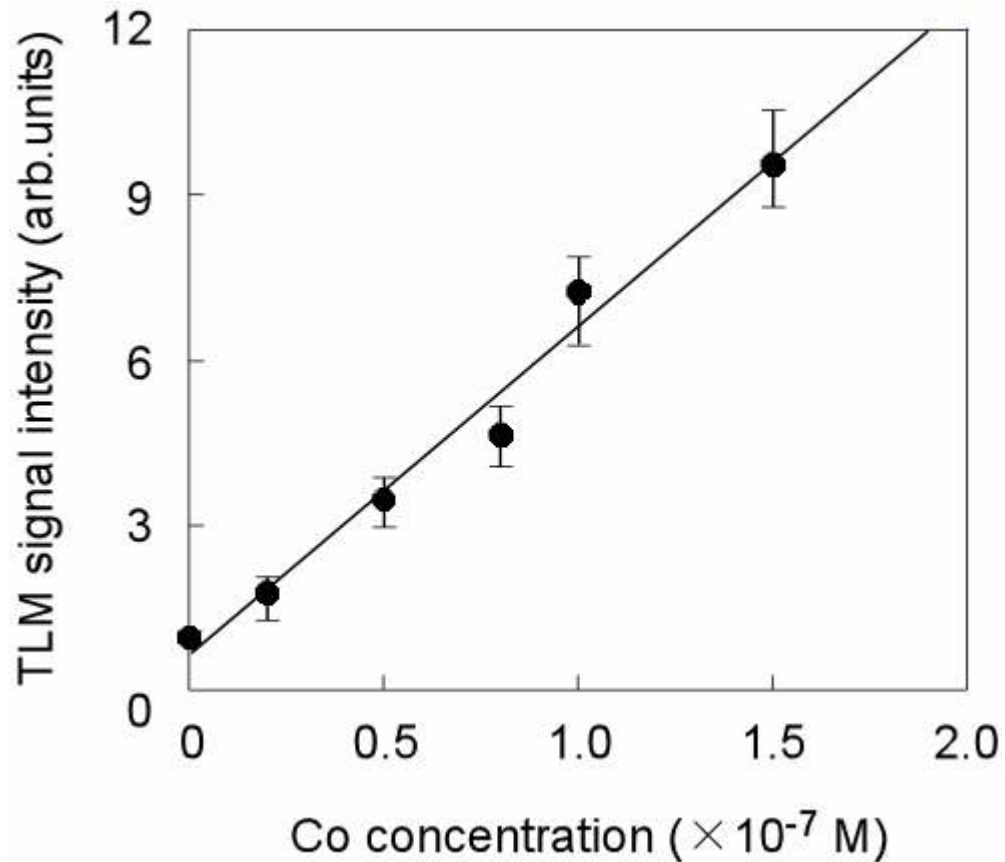


Co: Analyte Cu: Interfering



Flow velocity:
3mm/s

Calibration Curve

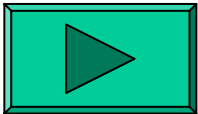
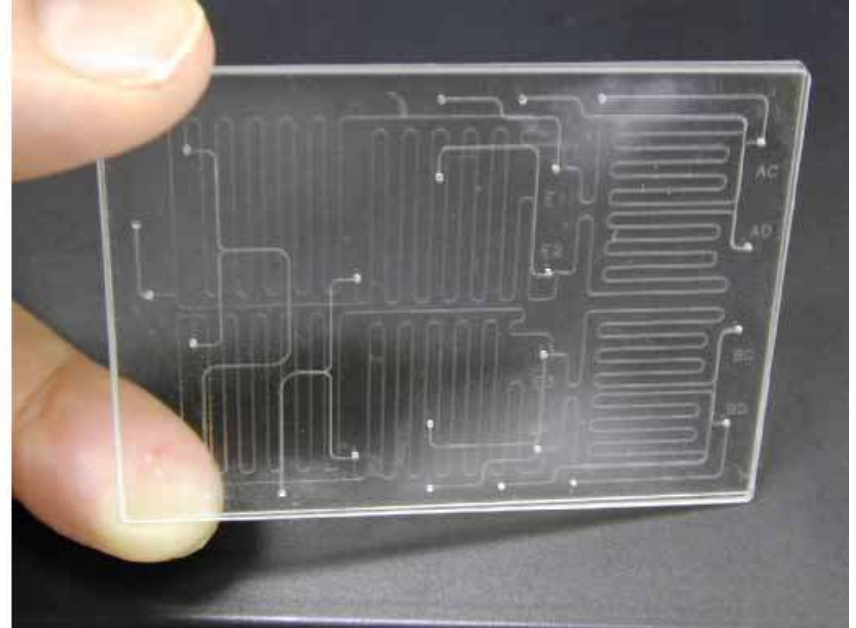
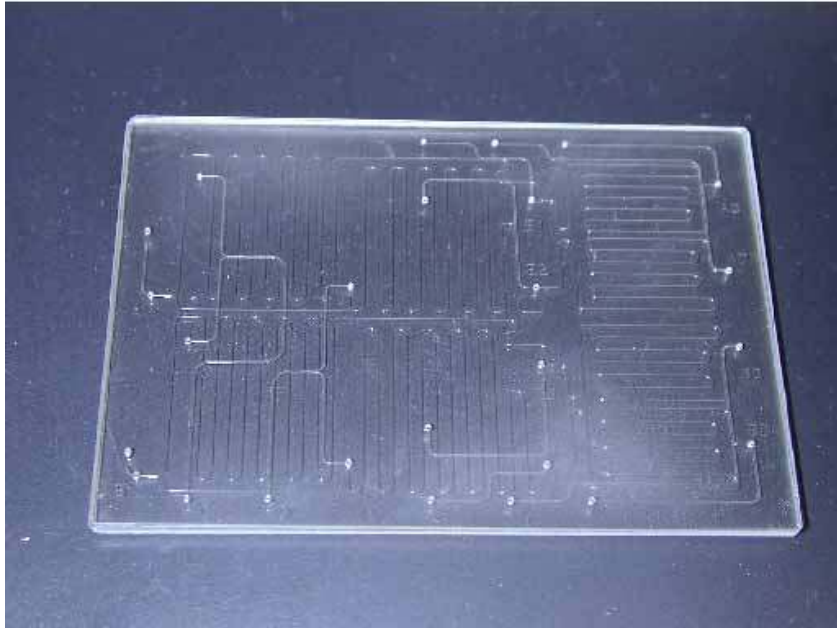


Limit of detection: 0.11×10^{-7} M

Absolute amounts
of detection: 0.08 zmol

3D CFCP (Ex. Fe & Co analysis)

Microchip With a 3-D Channel Network



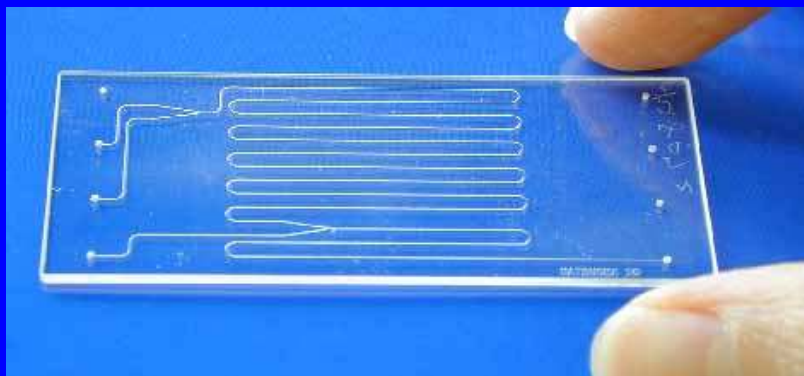
Multi-Sample Multi-Component Wet Analysis

	Sample C Fe (aq.)	Sample D Co (aq.)
Reagent A	41.0	0.6
Reagent B	0.2	12.3

Reagent A: bathophenanthroline

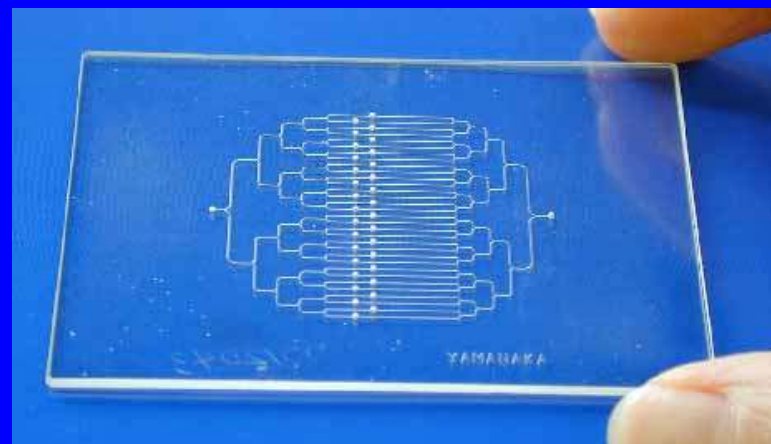
Reagent B: nitroso-PSAP

Examples of Integrated Chemical Devices



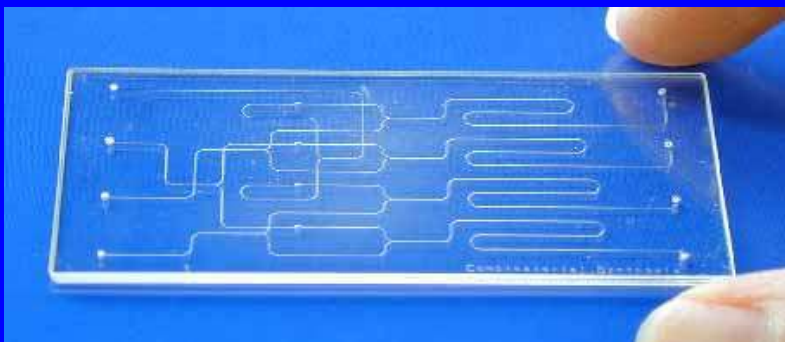
Chemical Analysis Device

- Environmental
- Biochemical

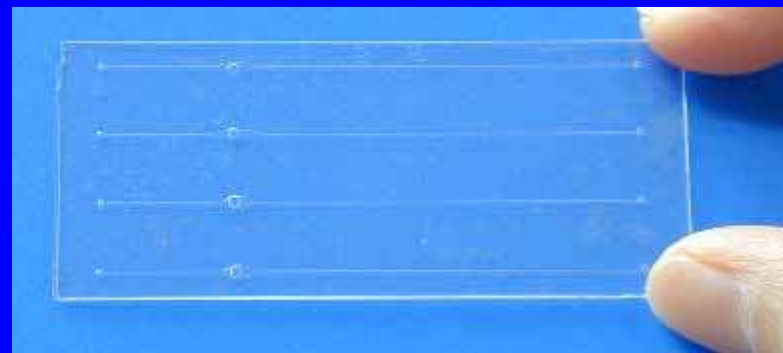


Immunoassay Device

- Cancer diagnosis
- Biochemical



Combinatorial Chemistry Device



Cell Biochemistry Device

Conclusions

- New methodology for integration of complicated chemical processing was established
 -
- Using this methodology, we applied Co and multi-sample multi-component wet analysis system

Acknowledgements



Mr. Yoshikuni Kikutani



Dr. Akihide Hibara



Dr. Hideaki Hisamoto



Prof. Takehiko Kitamori

Financial Supports

- Kanagawa Academy of Science and Technology
- The Grant-in-Aid for Scientific Research from the Ministry of Education, Science, Sports and Culture of Japan

Thank you for your kind attention

Experimental Setup

