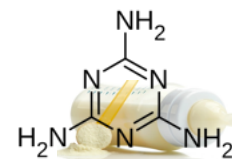


Background :

- Harmful substances such as **cyromazine** or **melamine** in daily foods, milk and animal feeds causes actual environmental and human health problems
- **Illegally** added to inflate the apparent protein content of food and animal feeds:
 - 50% of dietary supplements are contaminated with melamine
 - Found in baby formula milk in China, 2008, which was responsible for severe **renal** problems and **kidney** stones in infants.



Food safety should be widely monitored and improved

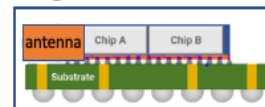
Targets:

We propose a portable and cost-effective scanner for real-time detection of contaminants in staple foods and/or animal feeds using **non-invasive** mm-Wave sensing with on-chip antenna-array system.

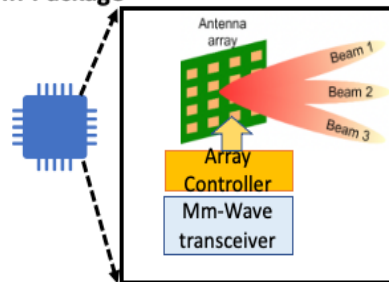
Speaker:

Nguyen Ngoc Mai-Khanh
System Design Center (d.lab)
The University of Tokyo, Japan

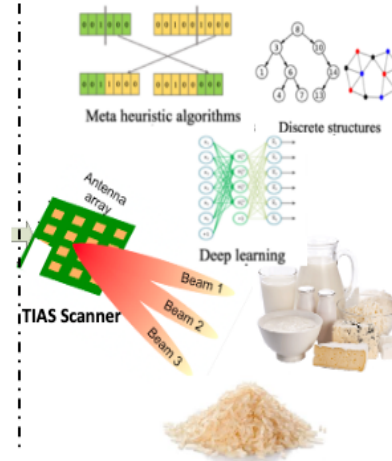
System-in-Package Tier



SiP TIAS Scanner with Antenna-in-Package



Sensing Application Tier





Project Title: 2.5D Technology-based Integrated Antenna Array mm-Wave System For Non-Invasive Food Safety Scanner (TIAS)

Project Members :

Name /Position/Institution	Name /Position/Institution
Nguyen Ngoc Mai-Khanh (Project Leader)/Assist. Prof./ The Univ. of Tokyo, Japan	Padapxay Sayakhot /Deputy Director General/IICT, Laos
Tran Thi My-Hanh /Vice-Director/Department Research Affiars, Nha-Trang Univ., Vietnam	Aromhack Saysanasongkham /Deputy Director/IICT, Laos
Pooja Shivanand Breh /Assist. Prof./Universiti Brunei Darussalam/Brunei Darussalam	Bich-Yen Nguyen /Senior Fellow/Soitec, Singapore
Gong Xiao /Assist. Prof./National Univ. of Singapore, Singapore	Chea Socheat /Researcher/National Institute of Posts, Telecoms & ICT, Cambodia
Vo Nguyen Quoc-Bao /Assoc. Prof., Dean/PTIT, Vietnam	Tetsuya Kawanishi /Prof./Waseda Univ., Japan

Associate Project Members

Name /Position/Institution
Sayfon Boutchanthath /Director General/IICT, Laos
Phonexay Namsavanh /Lecturer/IICT, Laos
Phuangkeo Keophengthong /Lecturer/IICT, Laos
Huynh Van Hoa /Lecturer/PTIT, Vietnam
Nguyen Duy Chinh /Lecturer/PTIT, Vietnam

Project Duration :

2 years
May 1st, 2021 to April 20th, 2023

Project Budget:

80,000USD

- **Time:** May 27, 2021, online by Zoom
- **Agenda:**
 1. Short introduction of members (1 minute for each)
 2. TIAS Overview and Plan
 3. Other procedures and information:
 - CRDA
 - Communication tool/channel:
 - Email group: OK
 - Social network: **Slack**
 - Working folder: Shared drive (Google)



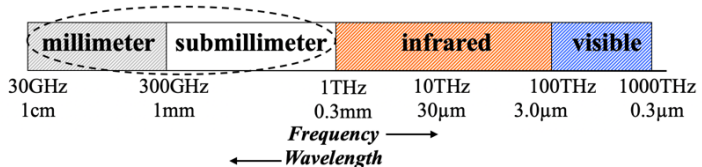
Attendance

Nguyen Ngoc Mai-Khanh, The Univ of Tokyo, Japan
 Tran Thi My-Hanh, Nha-Trang Univ, Vietnam
 Vo Nguyen Quoc-Bao, PTIT, Vietnam
 Bich-Yen Nguyen, Soitec, Singapore
 Chea Socheat, NIPICT, Cambodia
 Gong Xiao, NUS, Singapore
 Sayfon Boutchanthath, IICT, Laos
 Padapxay Sayakhot, IICT, Laos
 Aromhack Saysanasongkham, IICT, Laos
 Phonexay Namsavanh, IICT, Laos
 Phuangkeo Keophengthong, IICT, Laos
 Pooja Shivanand Breh, Brunei Darussalam
 Tetsuya Kawanishi, Waseda University, Japan

Topic: Chemical Sample Preparation and Mm-Wave Measurement Setup

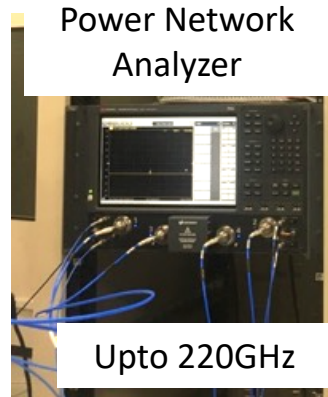
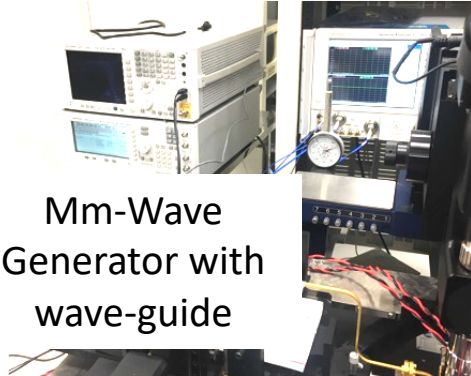
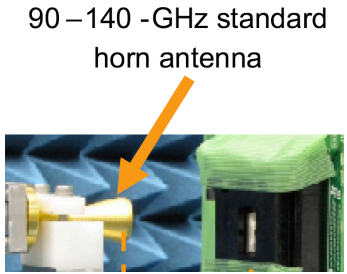
- Attendees:**

- Dr. Mai-Khanh, Univ. of Tokyo, JP (UTokyo)
- Prof. Kawanishi, Waseda Univ., JP (WU)
- Bich-Yen, Soitec, Singapore
- Dr. Pooja, Universiti Brunei Darussalam, Brunei (UBD)
- Prof. Quoc-Bao, Posts and Telecommuncations Inst. of Technology, Vietnam (PTIT)
- Dr. My-Hanh, Nha-Trang Univ., Vietnam (NTU)



- Notes:**

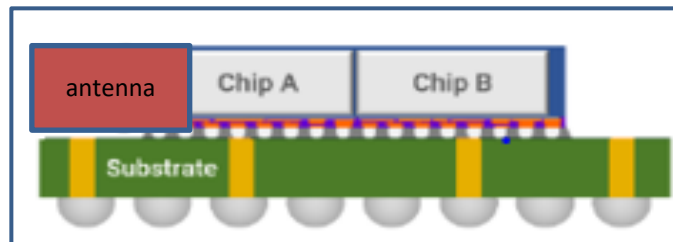
- Target frequency range for sensing: might be 60 – 140GHz
- Measurement Setup: mm-Wave & THz facilities supported by UTokyo and Waseda Univ.
- Chemical samples prepared by UBD and NTU



Meeting Topic: Antenna Array Design & Fabrication

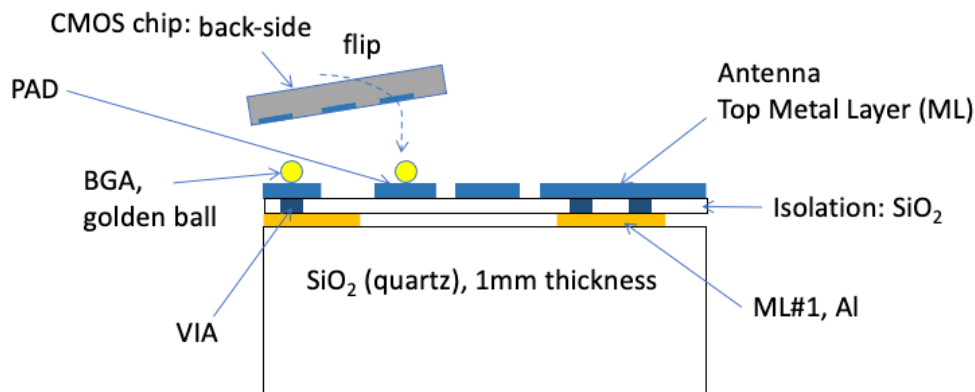
- Attendees:**

Dr. Mai-Khanh, Univ. of Tokyo, JP (UTokyo)
 Prof. Gong Xiao, National Univ. of Singapore (NUS)
 Bich-Yen, Soitec, Singapore
 Prof. Quoc-Bao, (PTIT)



- Notes:**

- Active circuits using CMOS process
- Passive components using on-glass substrate fabrication
- Antenna/antenna array and mm-wave components designed by UTokyo
- On-glass fabrication by Soitec and NUS



Chemical Sample (UBD)

1. Melamine concentration

Sample type	Melamine concentration/ Detection Limit (ppm)				
Milk	0	0.2	0.5	1	2
Soy milk	0	0.2	0.5	1	2
Liquid infant formula	0	0.2	0.5	1	2
Milk powder	0	0.5	1	2	4
Cereal	0	0.5	1	2	4
Wheat gluten	0	1.0	2.0	5.0	10.0
Powdered eggs	0	1.0	2.0	5.0	10.0
Animal feed	0	1.0	2.0	5.0	10.0
Poultry meat	0	1.0	2.0	5.0	10.0

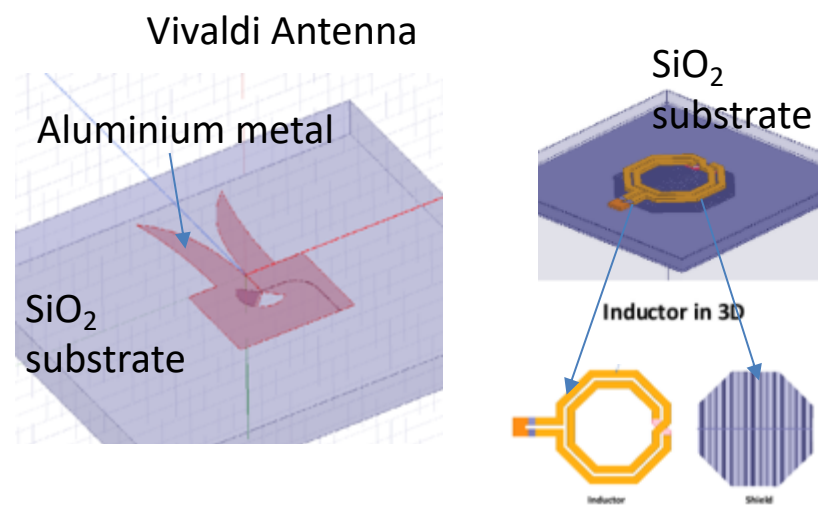
Bioo food and feed safety; www.Biooscientific.com

2. Sample size:

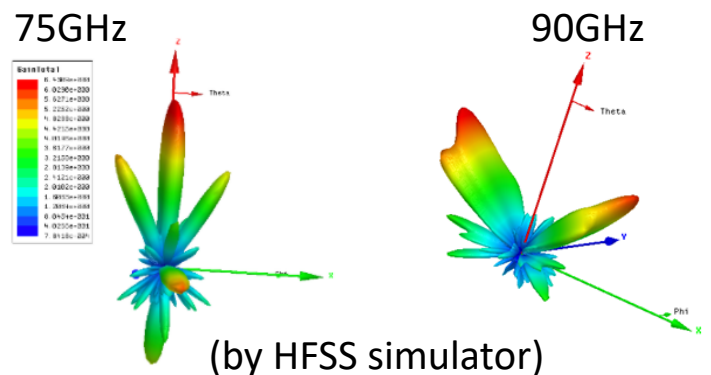
Depending on Measurement setup & equipment:

- Antenna size, co-planar size
- Equipment

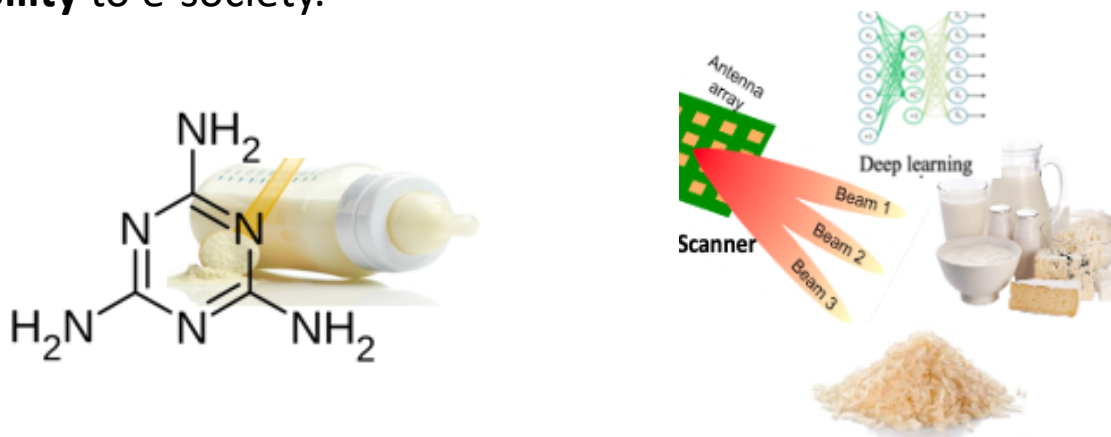
Antenna & Inductor (UTokyo)



Simulated Radiation Pattern



- Broader impacts on different angles including advanced research, practice, and education
- **Advance the research** of food safety by integrating the latest portable semiconductor technologies such as antenna, and the advanced 2.5D integration technology
- Open vast opportunities to build fast, cheap, compact and energy-efficient mmW for developing countries
- For a look ahead, the project aims to build an Artificial Intelligence and Internet-of-Things (**AIoT**) **library** for mm-Wave-based sensing data as well as a **database** for consumer users with a **traceability** to e-society.



We have done several tasks as followings:

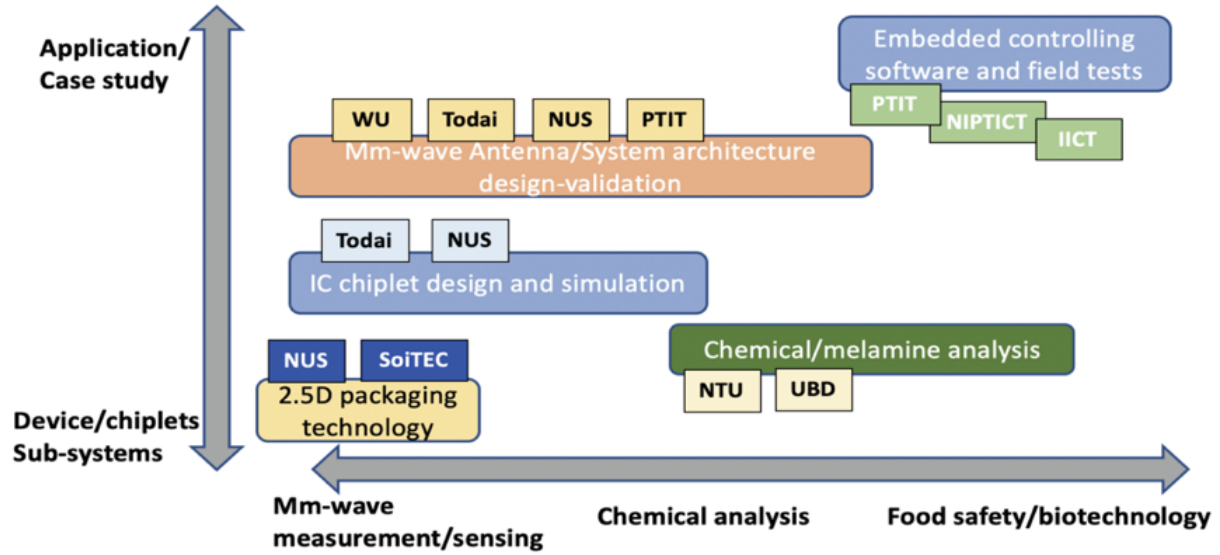
1. Scientific and technological:

- Successfully designed an on-glass Vivaldi antenna for the range of 60 – 94 GHz for the purpose of sensing
- Melamine sample preparation for the detection plan

2. Application development & experiment

- For estimation, we plan a mm-wave/THz measurement setup using horn antenna, PNX, spectrum ana.
- On-glass fabrication process: design & implementation

- **Define the mm-wave specification for detecting harmful substances:**
- **Build a heterogeneous integrated mm-Wave sensing system:**
 - Setting up a *2.5D modelling platform* for implementing the proposed mm-wave system
 - Design on-chip *antenna array* and then integrate it with the transceiver
- **System Implementation, Calibration & Validation**
- Develop a prototyping system being used in the food safety sector currently.
- Data collecting and creating a *big database* of harmful food substances.



TIAS