14. BIOMICROFLUIDICS AND POLYMER OPTOELECTRONIC TECHNOLOGIES

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RESEARCH TOPICS

Food safety diagnostic rapid tests

- Sensitive detection of pathogens based on DNA fingerprint
- Foodborne parasitology

Diagnostic devices for human healthcare applications

- Circulating Tumor Cells (CTC)
- Blood analysis

Sample preparation methods for downstream processing

- Particle separation methods: hydrophoresis and acoustophoresis

The main aim of our Biomicrofluidics Laboratory is to design and fabricate devices for medical, veterinary and industrial applications. We are focusing on the miniaturization of bioanalytical processes into microfluidic devices. Fundamental and applied research is carried out in collaboration with research institutes and industrial partners.

Food safety diagnostic rapid tests

Food safety describes handling, preparation and storage of food in ways that prevent foodborne illnesses. We are developing novel methods to detect foodborne pathogens in order to aid medical doctors, veterinarians and laboratory attendants. Also, foodborne pathogen testing and detection is a major concern for food industries. Our highlighted ongoing research project is to combine traditional sample preparation techniques with genotype sequencing within a single microfluidic device. Our lab developing tests for common foodborne parasitoses and Listeria.

Diagnostic devices for human healthcare applications

Our work in this field is focused on the analysis of serological samples. We are developing tools for the separation and analysis of extracellular microvesicles/exosomes secreted during cell-to-cell communication and tumor development; also, applications in circulating tumor cell (CTCs) separation are investigated. CTCs are thought to be responsible for a majority of cancerous metastases.

Particle separation

The separation of sub-micron and micron-sized particles is a challenging research area in microfluidics. The advancements in microfluidics enable sorting technologies that combine the benefits of continuous operation with small-sized scale suitable for manipulation and probing of individual particles or cells. Continuous separation and sorting of microparticles can be managed using external forces (acoustophoresis, electrophoresis, magnetophoresis, applying mechanical forces and optophoresis) or using exquisite geometric microchannels (hydrophoresis). Our work is focused on label-free, continuous and effective methods: hydrophoresis and acoustophoresis. Hydrophoresis is achieved by varying the geometry of the microfluidic channels, which in turn effectively manipulates the particles (transport, separation and sorting). Acoustophoresis is an ultrasound-based manipulation of microparticles, where mechanical and acoustic particle properties (size, shape, density, and compressibility) determine the manipulation effects.

Particle recognition and classification is crucial for the verification of separation techniques. We use high-fps camera systems (e.g. Cellular Nonlinear Network based machines) for real-time recognition, classification and counting of different objects (particles, cells or debris).

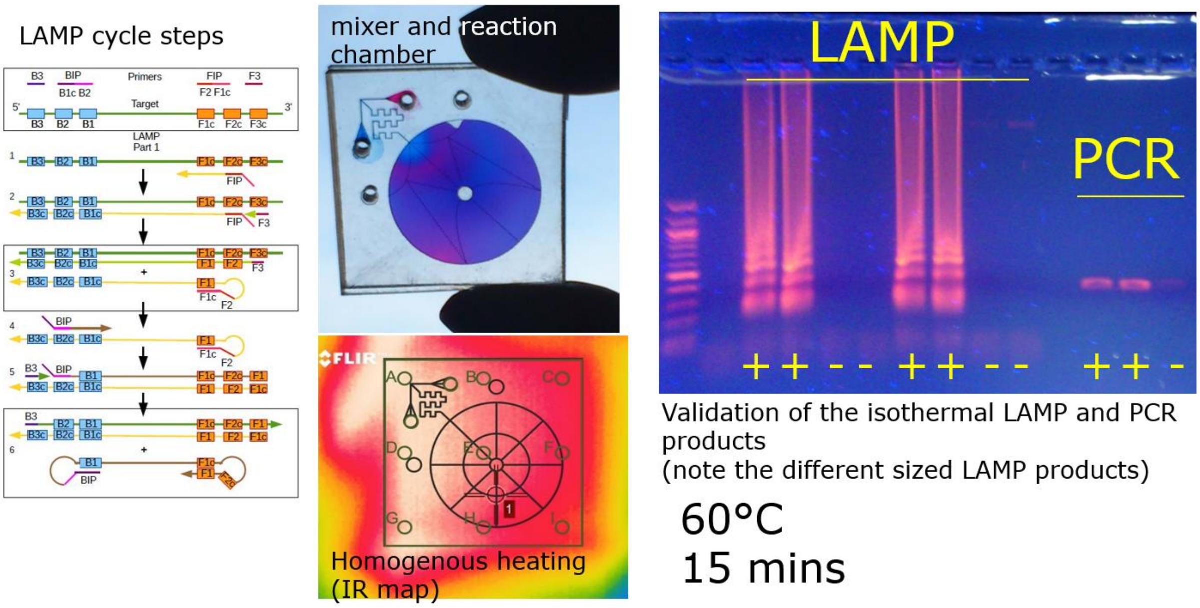

Fig. 1 *Detection of a specific gene from L. monocytogenes by the isothermal PCR method (LAMP) – amplification and detection*

PUBLICATIONS

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