Diagnostic platforms for scalable and accessible disease screening

Fabio Lisi[1,2], John Li[1], Keisuke Goda[2,3,4]

[1] *Department of Chemistry, The University of Tokyo, Tokyo 113-0033, Japan*
[2] *Radetec Diagnostics, Melbourne, Victoria 3128, Australia*
[3] *Department of Bioengineering, University of California, Los Angeles, CA 90095, USA*
[4] *Institute of Technological Sciences, Wuhan University, Wuhan 430072, China*

Early and rapid disease detection is one of the most impactful frontiers in modern healthcare, with the potential to improve treatment outcomes and reduce societal costs. In this presentation, I will introduce two approaches that I am currently pursuing, aimed at addressing this challenge across both infectious and non-infectious diseases.

In the first part, I will focus on infectious diseases, particularly *Chlamydia*—the most common sexually transmitted infection (STI) in humans, which also affects several animal species. In Australia, koala populations are severely threatened by *Chlamydia* infections, and part of my work at Radetec Diagnostics (Melbourne) focuses on developing a portable test for *Chlamydia* detection in koalas directly in the field, without the need for laboratory infrastructure. This technology provides a blueprint for accessible diagnostics in remote or resource-limited settings. Starting from the development of a rapid antigen test based on fluorescent quantum dots, I will discuss how nanoparticle surface chemistry was modified to optimise sensitivity, and present the evolution of the platform from antigen detection to a hybrid nucleic acid amplification test with endpoint detection on a nitrocellulose strip.

In the second part, I will present my ongoing research at the University of Tokyo in the laboratory of Prof. Keisuke Goda, focusing on liquid biopsy technologies for cancer screening. Our approach targets extracellular vesicles (EVs)—lipid bilayer-delimited nanovesicles naturally released from cells—to achieve non-invasive, high-sensitivity detection of early-stage cancer. We have developed a novel strategy to selectively isolate cancer-derived exosomes from healthy ones by exploiting the overexpression of sialic acid residues on the membranes of various cancer types. By targeting these residues in EVs originating from triple-negative breast cancer (TNBC) cells, we achieved a limit of detection of approximately 1,000 EVs/mL in blood and successfully discriminated between samples from TNBC patients and healthy individuals, demonstrating the strong potential of this technology to transform cancer diagnostics.