Construction of virus-like particles by cell-free system and microfluidics technology

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We develop a platform to construct virus-like particle (VLP) based on the technologies of cell-free protein synthesis system and microfluidics and apply the VLP as a vaccine that can rapidly respond to the spread of viral infection.

Liposomes and lipid nanoparticles are widely applied as carriers for gene or drug delivery. Liposomes are mainly composed of phospholipids and are formed around 100 nm size, which is almost the same size as a virus. Therefore, it could be used the liposomes as an artificial vaccine. However, in order to use liposomes as vaccines, viral proteins that work as antigens must be presented on the membrane surface. The conventional methods require the steps to purify viral membrane proteins with a high degree of purity and reassemble them into the liposome membrane, those are time-consuming experiments that involve the risks of failure.

To overcome such difficulties, we propose a brand-new method based on the cell-free protein synthesis system (cell-free system) and microfluidics technology. Cell-free system, which performs transcription and translation in vitro, synthesizes virus envelope proteins and localizes them onto the liposome surface. Because the reaction completes in a few hours, VLPs can be rapidly prepared while avoiding experimental errors. Additionally, the originally designed microfluidic devise enables the formation of highly controlled lipid particles that are decollated with antigen proteins and the encapsulation of therapeutical molecules such as RNA or anticancer drugs.

Based on this idea, we try to produce rabies vaccines that form proteoliposomes containing G-protein of the rabies virus. Non-clinical PoC using a model mouse is planned in this project period (2024.6-2025.9).