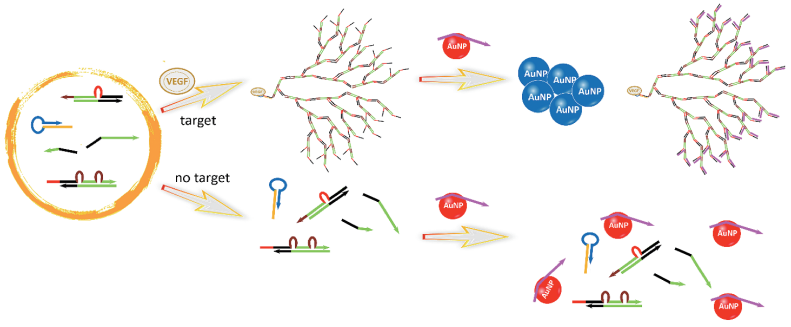
An enzyme-free colorimetric assay for the rapid detection of specific target proteins

A label - and enzyme - free colorimetric sensing platform for the amplified detection of target proteins was developed based on the ingenious combination of a nonlinear hybridization chain reaction system and a gold nanoparticle aggregation strategy

The combination of gold nanoparticles (AuNPs) and DNA has a history that spans two decades with potential applications as biosensors in biomedicine. Now, Prof. Chii-Wann Lin's group from the Institute of Biomedical Engineering have identified a new method for using AuNPs with DNA that takes advantage of a technique called nonlinear hybridization chain reaction (NHCR), which refers to the formation of dendritic DNA nanostructures through a self-sustained, branching growth mechanism.

Here, these researchers developed a method to control the assembly of AuNPs using a similar nonlinear hybridization chain reaction technique. DNA aptamers selected to bind specific molecules show promise for the development of NHCR triggers that initiate a chain reaction only in the presence of the target molecule. A programmed DNA dendritic nanostructure is formed via a target-assisted cascade amplification reaction using two double-stranded DNA substrates and two single-stranded auxiliary DNA molecules as assembly components, and the resulting dendritic nanostructure is subsequently captured using DNA-sensing probe-stabilized AuNPs. The release of the sensing probes from the AuNPs results in the formation of unstable AuNPs, promoting salt-induced aggregation. Prof. Lin and co-workers have used this aptamer-trigger concept to specifically detect vascular endothelial growth factor (VEGF). This assay does not require time-consuming AuNP surface modification and enzymatic amplification steps. Additionally, this assay requires less than an hour for completion compared with DNA-based linear amplification detection, which takes several hours to complete. Prof. Lin remarked, "If we succeed in developing a general aptamer triggering mechanism for biosensing, then NHCR amplification could be incorporated in sensors for a wide range of biomolecules."



Colorimetric detection of VEGF using DNA sensing probe-stabilized AuNPs

Prof. Lin's group also currently works with mobile platforms for on-site testing and healthcare. Thus, in the future, this technique could be applied for point-of-care quantitative detection using a smartphone-based device.

Reference

Chia-Chen Chang, Chen-Yu Chen, Tsung-Liang Chuang, Tzu-Heng Wu, Shu-Chen Wei, Hongen Liao, Chii-Wann Lin, Aptamer-based colorimetric detection of proteins using a branched DNA cascade amplification strategy and unmodified gold nanoparticles. Biosensors and Bioelectronics 78, 200–205 (2016). DOI: 10.1016/j.bios.2015.11.051.

Professor Chii-Wann Lin
Institute of Biomedical Engineering
cwlinx@ntu.edu.tw