Liquid crystals for chemical and biological sensing applications

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Human eyes can distinguish about 10 million different colors but only 100 different grey scales. Therefore, in bioassays or biosensors, a readout system that is based on different colors rather than different light intensities provides tremendous advantages. Liquid crystals (LCs) are materials known to give many different colors depending on their average orientations. Recently, it was discovered that the orientations assumed by LCs near surfaces are very sensitive to surface topography, chemical functionality and molecules adsorbed on surfaces. Therefore, LCs can be used to amplify molecular binding events into colorful LC signals which are readily visible to the naked eye. This phenomenon has led to the development of a new class of LC sensors with unprecedented sensitivity and convenience such as the LC-based immunoassays shown in Fig. 1. In this presentation, I will discuss my research in LC and a variety of LC-based chemical and biological sensors [1–4] which have broad applications in environmental monitoring, clinical diagnosis and defense.

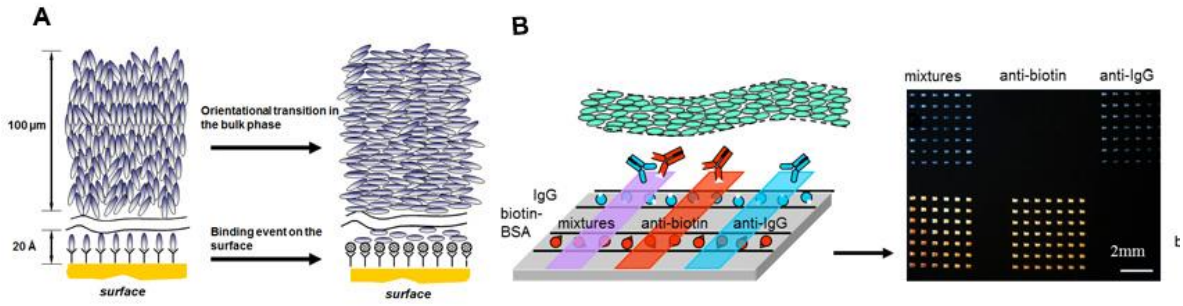

Fig. 1. LC-based microfluidic immunoassays which give visible colors to the naked eye.

References

[1] Zhu, Q. & Yang, K.-L., "Microfluidic immunoassay with plug-in liquid crystal for optical detection of antibody," *Analytica Chimica Acta,* **853**, 696-701 (2015).
[2] Chen, C.-H. & Yang, K.-L., "Liquid crystal-based immunoassays for detecting hepatitis B antibody," *Analytical Biochemistry,* **421**, 321-323 (2012).
[3] Chen, C.-H. & Yang, K.-L., "Functional protease assay using liquid crystals as a signal reporter," *Biosensors & Bioelectronics,* **35**, 174-179 (2012).
[4] Xue, C.-Y., Khan, S.A. & Yang, K.-L., "Exploring optical properties of liquid crystals for developing label-free and high-throughput microfluidic immunoassays," *Advanced Materials,* **21**, 198-202 (2009).

Speaker Biography

Yang Kun-Lin is an associate professor in the Department of Chemical and Biomolecular Engineering at the National University of Singapore (NUS). Before joining NUS, he was a post-doctoral researcher in the Chemical and Biomolecular Department at the University of Wisconsin - Madison. He received his PhD degree from Georgia Institute of Technology in 2002. He is the recipient of Defense Innovation Research Program Award in 2009, A*Star Research Grant Awards in 2006, 2008 and 2015 for his work on microfluidic – liquid crystal sensors and TechConnect Award for his solid-state fermentation technology. His present research interests include biosensors, liquid crystals, microfluidics, and microbes for molecules. He is also a winner of several teaching awards, including NUS annual teaching excellence award in 2013, 2014 and 2015.