O40

Refractive Index Detector Based on a Young Interferometer for Electroseparation Methods

Ruchi Gupta
University of Birmingham, Birmingham, United Kingdom, r.gupta.3@bham.ac.uk

Summary

Detectors based on absorption [1], fluorescence [2], and refractive index (RI) [3] have been reported for electroseparation methods. RI detectors are universal but are less sensitive than absorption and fluorescence detectors. The detection limit of RI detectors is ≈10^{-6} M for proteins, corresponding to a RI resolution of ≈10^{-5} refractive index units (RIU).

In this presentation, I will describe a RI detector based on an optofluidic Young interferometer (YI) with two wedge-shaped light beams that passed through the depth of sample and reference microfluidic channels where electroseparations occurred. The two beams then overlapped with each other to produce interference fringes that contained information on the RI difference between each point in the sample and reference microchannels. The RI difference is related to the concentration of analyte bands/peaks. Our YI provided whole channel visualisation of electroseparation methods with a spatial resolution of 295 µm along the length of microchannels.

The RI resolution of our YI was 2.04 × 10^{-6} RIU per mm of the optical pathlength and can be tailored by changing the depth of microchannels. By using a Fresnel biprism with a cylindrical lens to generate two virtual slits, we obtained high quality, high intensity interference fringes without diffraction effects from the channel edges, which in turn allowed short camera acquisition times. Further, we developed a fast Fourier transform algorithm for real-time analysis of interference fringes, and obtained a temporal resolution of 2 s. Finally, we applied our YI to study electrophoretic transport [4] and electrophoresis combined immunoassays of exemplar proteins, and pre-concentration of oligonucleotides by isotachophoresis.

References

[1] R. Imai, K. Osawa, T. Anazawa, Multi-channel Deep-UV absorbance measurement setup for multi-capillary electrophoresis with two fiber arrays facing each other, Talanta 266 (2024) 125065.
[2] C.E. MacTaylor, A.G. Ewing, Critical review of recent developments in fluorescence detection for capillary electrophoresis, ELECTROPHORESIS 18 (1997) 2279–2290.
[3] J. Wu, J. Pawliszyn, Capillary isoelectric focusing with a universal concentration gradient imaging system using a charge-coupled photodiode array, Anal. Chem. 64 (1992) 2934–2941.
[4] R. Gupta, E. Labella, N.J. Goddard, An optofluidic Young interferometer sensor for real-time imaging of refractive index in µTAS applications, Sens. Actuators B Chem. 321 (2020) 128491.