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# Nano-droplets mixing in a microfluidic platform: a novel approach for enhancing chemiluminescence signal intensity at low microflow rates.

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## Abstract

Most chemiluminescence (CL) systems rely on fast chemical reactions to generate a useful CL signal. However, fast chemical reactions face difficulties in microfluidic systems due to the short residence time and the relatively slow mixing process. The slow mixing inside the microfluidic channel is mainly due to the laminar nature of the flow inside the channels which, in turn, limit the mixing to the diffusion process only. Therefore, to maximize the CL signal intensity, it is of an utmost importance to enhance the mixing process inside the microfluidic channel [1].

Several interesting chip designs have been attempted to achieve this goal like a ‘staggered herringbone mixer’, serpentine, spiral, flow splitting, teardrop and combined spiral & flow split design [1-2].

Here, we utilized the mixing enhancement due to the formation of nano-droplets in a microfluidics platform (Nano-droplets mixer chip) to obtain high CL signal intensity. Two CL systems were tested and evaluated, potassium permanganate/formaldehyde and soluble colloidal manganese (IV).

Optimization of the instrumental setup and experimental conditions must be employed in order to obtain high sensitivity. Several experimental parameters were thoroughly optimized, including the order of injecting the analyte and CL reagents, type of oil and surfactant.

The droplet size was observed to be between 100 to 115 nl and the mixing efficiency of the nano-droplets was compared with the CL signal intensity obtained using the common serpentine chip design, with both approaches being employed at the total flow rate of the CL reagents of 10  $\mu$ L min<sup>-1</sup>, and the results showed that the Nano-droplets provided 600% higher CL signal intensity at this low flow rate.

References:

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- 2- H. A. J. Al Lawati, A.M. Kadavilpparampu, F.O. Suliman, Talanta, 2014, 127, 230-238.

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