17p-C1-11

Optimization of CW-PA Protocol Using Dual Wavelength Excitation Sequence for the Highly Sensitive and Selective Measurements of Blood Glucose Levels

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Recently, we developed two protocols based on the continuous-wave photoacoustic technique for the Noninvasive and continuous blood glucose monitoring: the frequency-shift and optical power balance shift (OPBS) [1]. The latter technique provides a response that is wavelength dependent and therefore opens the door to compound specific detection similar to absorptiometry by multiplexing the wavelengths. However, the targeted application also requires high sensitivity in the low milligram per deciliter concentration range, and optimization of the protocol was then performed in an effort to meet this requirement. The OPBS method relies on a dual wavelength excitation with two laser sources operating at different wavelengths and driven by square wave signals at the same frequency but in opposite phase (Fig. 1). Among the several parameters investigated, the phase difference between the two optical beams was found to drastically affect both the amplitude and phase signals (Fig. 2). In order to get a real π-phase difference at the coupler, the phase difference set at the FG should take into account the phase-lag introduced by the two lasing systems operating in parallel. Since the OPBS measurements rely on the detection of the shift along the X-axis, sharpening the features by adjusting the phase shift at the FG source should lead to a drastic increase in the measurement accuracy and therefore its sensitivity, despite an overall constant compound dependence.

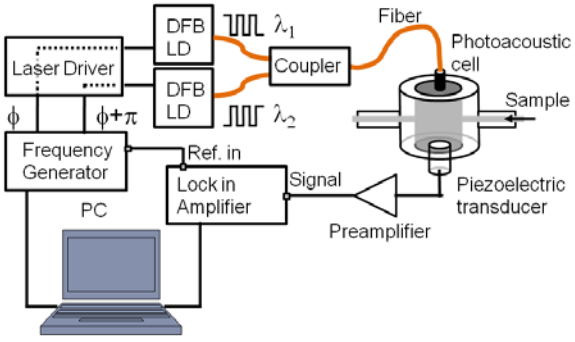

Figure 1. Experimental setup for the OPBS-based measurement of liquids.

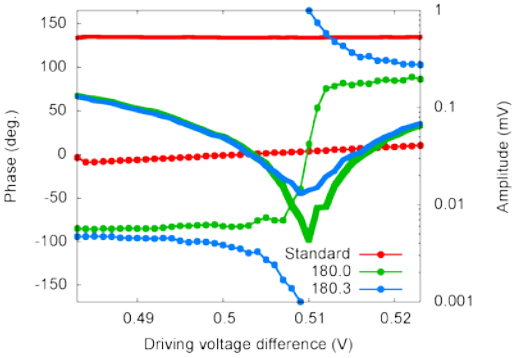

Figure 2. OPBS-based amplitude (plain lines) and phase (dotted lines) response for pure water at three phase differences between the two optical wavelengths.

[1] S. Camou *et al.*, book chapter in "Pervasive & Mob. Sens. & Comp. for Healthcare" (in press)