Leucocyte measurements during whole blood monitoring by infrared spectroscopy: novel opportunities for testing the hemocompatibility of materials?

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The chemical and cellular composition of whole blood is a valuable indicator of the human health status and for medical diagnostics. Clinical investigations of whole blood can be successfully carried out using infrared spectroscopy for chemical analysis.[1,2] In particular, a major focus is on the quantitative measurement of substrates such as glucose and metabolites in a complex matrix that includes cellular components. Transmission measurements are most promising since adsorption effects on the cell windows should advantageously give rise to fewer complications than those experienced with the attenuated total reflection technique (ATR). The latter is known to be sensitive to the adsorption of proteins onto the ATR crystal. We report on a cellular adsorption process experienced over a period of several hours under continuous blood flow conditions using a cell of 30 µm path length equipped with CaF_2 windows. Interpretation of the spectral features observed during cell window deposit growth uniquely underlines the fact that leucocyte adsorption is responsible for diminishing the free cell path length at the flow conditions chosen. The adsorption dynamics have been characterised and cellular chemical changes monitored over night with exposure of the cells to physiological saline solution. A novel tool for hemocompatibility testing of materials that are applicable for cell window coating is suggested using transmission infrared spectroscopy.

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Keywords: mid-infrared spectroscopy, leucocytes, whole blood measurements, cellular adsorption, material hemocompatibility

References:

[1] H.M. Heise, Biomedical Vibrational Spectroscopy - Technical Advances, in: P. Lasch and J. Kneipp (eds.): "Biomedical Vibrational Spectroscopy", pp. 9-37, Wiley (2008).

[2] H.M. Heise, Clinical applications of near and mid-infrared spectroscopy. in: H.U. Gremlich and B. Yan (eds): "Infrared and Raman spectroscopy of biological materials", pp 259–322, Marcel Dekker Inc., New York (2001).