Principal Component Analysis of Raman spectra of red blood cells to study biochemical signature of ageing process

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Red blood cell's (RBC) ageing is a physiological process, fundamental to ensure a proper blood homeostasis that, *in vivo*, balances the production of new cells and the removal of senescent erythrocytes. Thus, a detailed characterization at the cellular level of the progression of the ageing phenomenon can reveal biological, biophysical and biochemical fingerprints for diseases related to misbalances of the cell turnover and for blood pathologies.

Many different techniques [1] have been used to investigate the modifications in the cell's dimension and shape and in the composition and oxidation state of the plasma membrane during ageing. In this work, we combined AFM imaging and Raman spectroscopy to analyse human RBCs. While high-resolution imaging characterized the morphological and mechanical effects of ageing, Raman spectroscopy provided a survey of the vibrational levels, to obtain characteristic mean spectra of single cells at different ageing times. Furthermore, by performing a statistical elaboration of the spectroscopy data through Principal Components Analysis (PCA), we highlighted subtle spectral differences associated with conformational and biochemical alterations induced by the progression of the ageing.

The collected data show a clear separation of the cellular spectra measured at different ageing times, opening the way to the efficient use of this technique for rapid, automatic and label-free assessment of cell status and evolution.

[1] "Structural, morphological and nanomechanical characterization of intermediate states in the aging of erythrocytes" M. Girasole, S. Dinarelli, G. Boumis Journal of Molecular Recognition 25 (2012) 285-291.