Application of Biospectroscopy to Characterise Cell-specific Functionality Based on Chemical Signatures: Applications to Stem Cell Biology

Francis L. Martin

Centre for Biophotonics, Lancaster Environment Centre, Lancaster University, Lancaster LA1 4YQ, UK
Corresponding author: f.martin@lancaster.ac.uk

The building blocks of a tissue's architecture are multiple cell types that are at various points in lineages towards differentiation or their useful lifespan. Cell-specific functionality will determine chemical composition of bio-molecular structures. Even similar cells with common functionality would be expected to differ in their chemical fingerprints. In general, tissues with a regenerative capacity (*e.g.*, the GI tract) are believed to contain stem cells (SCs) that divide symmetrically or asymmetrically to give rise to transit-amplifying (TA) cells that are then committed to generating terminally-differentiated (TD) cells. Especially in human-derived tissues, application of conventional methodologies such as antibody-labelling of single epitopes has failed to result in convincing SC markers. In contrast, application of biospectroscopy methods generates an integrated chemical signature in the form of a spectrum; this can then be related to structure and function. Given the number of data points within such a signature (typically 200 to 300) and the differing cell dynamics in a given tissue, large and complex datasets are generated. Extracting the vital cell-specific discriminating variables can initially be approached using exploratory approaches such as principal component analysis and/or linear discriminant analysis. There is already compelling evidence that such an approach can segregate putative SCs from TA cells from TD cells in different tissues. Ultimately, this could allow one to identify the spectral profile considered normal; deviations from this would point to various pathological states. In the future laboratory setting, biospectroscopy methods will shed novel microscopic insight into the function and role of the biological cell.