Single cell monitoring of redox potential using Surface-enhanced Raman Spectroscopy

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Intracellular redox potential is involved in many cellular functions, such as the cell cycle, signalling and protein folding. It is tightly controlled, and its dysregulation is associated with several disease states, including cancer, inflammation and heart disease. We have created redox active probe molecules that change structure depending on their oxidation state, and developed a protocol for coating gold nanoshells with these probes. Surface-enhanced Raman spectroscopy (SERS) of the coated nanoshells allows spectral discrimination and quantification of the ratio of oxidised and reduced states, and thus calculation of the local redox potential.

The initial aim of this project was to optimise the protocols for rapidly and reproducibly acquiring SER spectra from our nanosensors in individual cells using a mapping technique (see figure). Current work is focused on methods for acquiring spectra from cells subjected to various oxygen concentrations and automating the data analysis of the SER spectra maps.

Further work will investigate how intracellular and extracellular redox potential are coupled and how redox potential changes at sub-physiological O_2 concentrations (in hypoxia). These new tools are likely to be useful for further developing our understanding of how altered redox potential may drive disease states.

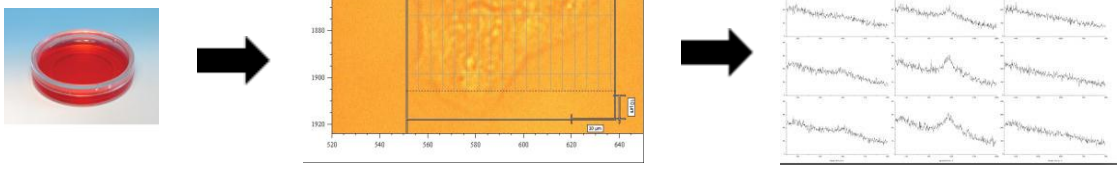

Plate cells in dish, add nanosensors

Select cell(s) to be imaged and perform map acquisition of spectra

An extract from a larger map, showing signals from one nanosensors inside a cell