Colloquium

Relaxometry for measuring free radical generation in living cells

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Host:

Free radical generation plays a key role in many biological processes including cell communication, immune responses and maturation. However, radical formation is also a hallmark of ageing and often elevated when cells experience stress. As a result, they are important in many different diseases including cancer, cardiovascular diseases or viral and bacterial infections. However, free radicals are short lived and reactive and thus difficult to measure for the state of the art. Also, since they occur in low concentrations, they are difficult to localise. We have circumvented this problem by using a technique which allows nanoscale MRI. This technique makes use of a defect in diamond which changes its optical properties based on its magnetic surrounding. Since optical signals are much easier to detect the method offers orders of magnitude better sensitivity. Here I would like to show our work in immune cells[1,2]. In these cells we were able to target nanodiamonds to single mitochondria and measure the metabolic activity of the organelles as well as their stress response[1]. We were able to conduct a similar study also in primary cells which where harvested from donors[2]. Despite these donors all being healthy there were drastic differences in how aggressive their dendritic cells reacted towards a stressor. With these measurements we could confirm that these differences that were also evident in other metabolic parameters also were obvious when observing free radical generation.Figure 1 – We investigated the stress response of dendritic cells from donors in an ex-vivo study using NV centers in nanodiamondsReferences[1] Nie, L., Nusantara, A.C., Damle, V.G., Sharmin, R., Evans, E.P.P., Hemelaar, S.R., van der Laan, K.J., Li, R., Martinez, F.P., Vedelaar, T. and Chipaux, M., 2021. Quantum monitoring of cellular metabolic activities in single mitochondria. Science advances, 7(21), p.eabf0573.[2] Nie, L., Nusantara, A.C., Damle, V.G., Baranov, M.V., Chipaux, M., Reyes-San-Martin, C., Hamoh, T., Epperla, C.P., Guricova, M., Cigler, P. and Van Den Bogaart, G., 2021. Quantum sensing of free radicals in primary human dendritic cells. Nano letters.

Monday, March 28, 2022 04:00pm - 05:00pm
Online

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