Imaging Nano-domains in Mammalian Membranes Using Super-Resolution Microscopy and Advanced Analysis

Every living thing is made up of different cells. The cells present mammals, including humans, are known as mammalian cells, and are separated into different subcategories. The basic structure of different mammalian cells is, however, the same. The outermost part of the cell is known as the plasma membrane and is responsible for shielding the inside of the cell from its surroundings, but also for exchange different compounds and signals between the inside and outside of the cells. The plasma membrane consists of mainly lipids with many proteins integrated into it. Many of these proteins are able to provide signalling processes to the inside of the cells. It has been found that areas of the plasma membrane organise into so-called nano-domains. These nano-domains have been found to assist the protein signalling process, but the specifics are yet to be determined. A disfunction of nano-domains have, however, been found to be involved in various diseases, including elevated blood pressure and heart diseases.

These nano-domains can, as a result of their size, be very challenging to analyse. Often the tool of choice for analysing nano-domains is to investigate the movement of molecules residing in the plasma membrane. During this work, the movement of membrane residing molecules was determined with the analysis techniques known as line fluorescence recovery after photobleaching, spatiotemporal image correlation spectroscopy, and k-space image correlation spectroscopy in various biological systems. The biological systems analysed were lipids in synthetic model membrane system and proteins in the plasma membrane of living cells.

From the abovementioned analysis, it was found that the line fluorescence recovery after photobleaching can successfully identify changes in lipid mobility in model membranes by altering nano-domains. Using spatiotemporal image correlation spectroscopy or k-space image correlation spectroscopy it was found that nano-domain correlation to different proteins can be identified in living cells by treatment with different molecules. Additionally, it was found that nano-domains can, depending on the treatment, control the cellular effect of proteins in the plasma membrane.