Molecular imaging of cells and tissues using Time of Flight- Secondary Ion Mass Spectrometry (ToF-SIMS): why physicists, chemists, statisticians and biologists are needed to solve hard biological problems

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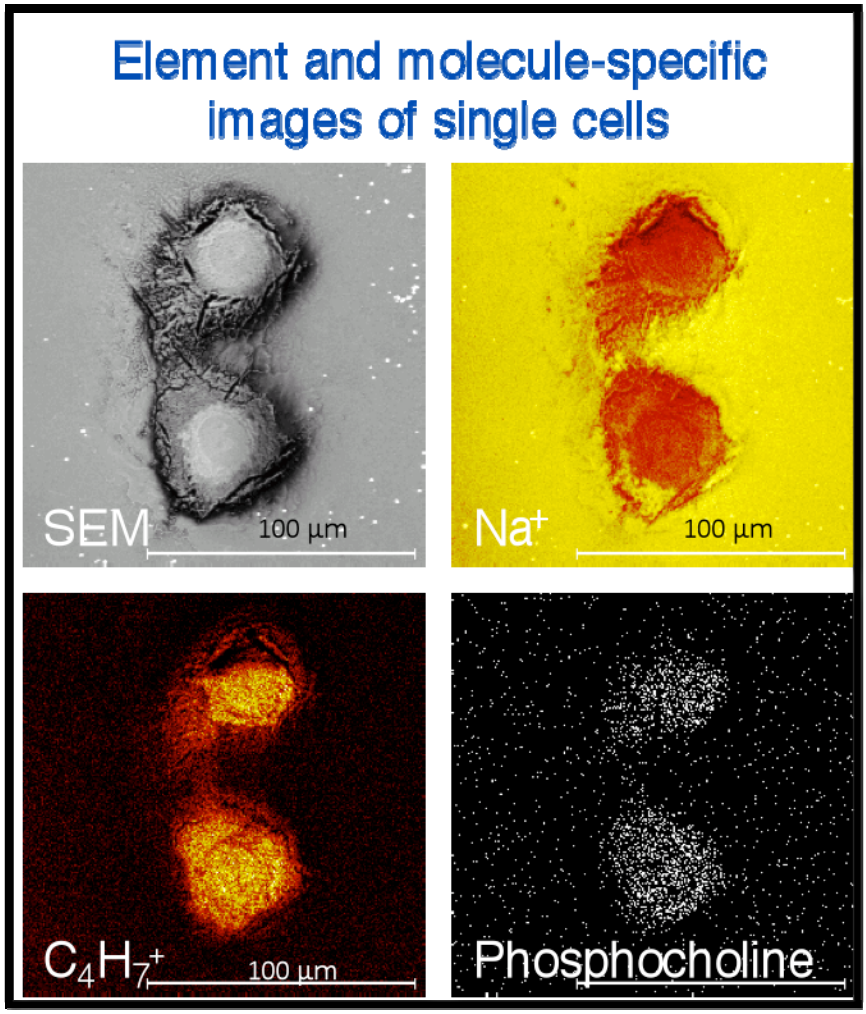
"A picture is worth a thousand words", and in biology, that picture is even more valuable if the image contains chemical information that can be used to understand cellular mechanisms or diagnose disease. We are using time-of-flight secondary ion mass spectrometry (ToF-SIMS) to image individual cells and tissue sections. ToF-SIMS images are composed of 65,536 region- specific mass spectra, which can be used to identify "chemical signatures" of specific areas within the sample. Using statistical data reduction, the chemical signatures can differentiate similar biological materials based on small changes in protein expression, metabolic activity and cell structure. Being able to discern small changes among similar samples allows us to understand changes that occur within cells during injury or progression toward disease. Ultimately, we would like to be able to predict the future behavior of cells or tissues (disease prognosis), based on the current chemical state of the cell. To achieve that goal, we will need the combined skills of physicists, chemists, statisticians and biologists, all working as a team to create and interpret the images. This presentation will discuss the basics of imaging mass spectrometry, what it is and how it works, and our progress in imaging cells and tissues for biomedical applications, with a focus on cancer diagnosis and prognosis.


Element and molecule-specific images of single cells
SEM
100 µm
Na+
100 µm
C4H7+
100 µm
Phosphocholine