Tracking a cell's mass in real time: a new indicator of cell physiology

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Regulation of cell volume and mass is physiologically important for living organisms, and dysregulation of these parameters is at the origin of many diseases[1]. Cell mass mainly comprises intracellular water, proteins, lipids, carbohydrates and nucleic acids and is tightly liked to metabolism, proliferation[2] and gene expression[3]. However, the mechanisms that regulate cell mass remain largely unknown.

Flow cytometers and Coulter devices are among the most commonly used technologies to characterize the volume of suspended cells. However, most mammalian cells are adherent and behave considerably different in the suspended and adherent state. Therefore, one should be able to determine the volume and/or mass in the adherent state. Over the recent years powerful technologies have emerged to track the mass of single suspended[4] and adherent[5-7] cells. However, it has not been possible to track individual adherent cells in physiological conditions at the mass and time resolution required to observe fast cellular dynamics.

I will introduce a picobalance that we have developed, which is based on an optically excited microresonator. It measures the mass of single or multiple adherent cells in culture conditions over days at millisecond time resolution and picogram (»0.1% of cell mass) mass sensitivity. I will also present some of the results we have obtained using this technology, including the detection of fast and subtle mass fluctuations that seem to be universal to living mammalian cells[8]. Our approach is easy to operate and compatible with state-of-the-art optical microscopies, therefore we anticipate it will contribute to the understanding of cell mass regulation.

Cell on the picobalance. One the best science images of 2017 according to Nature.

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