Non-contact laser catapulting and high-throughput specimen capture opens new horizons in functional genomics and proteomics

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The understanding of the molecular mechanisms of cellular growth and proliferation necessitates accurate identification, isolation and finally characterization of a specific cell or a population of cells and subsequently their specific subsets of biomolecules. Sample preparation is therefore a very crucial step for high-resolution downstream applications. For the simultaneous analysis of thousands of molecular parameters within a single experiment as realized by DNA, RNA and protein microarray technologies a defined number of homogeneous cells derived from a distinct morphological origin is required.
Laser Microdissection and Laser Pressure Catapulting (LMPC™) enables pure and homogeneous sample preparation resulting in an eminent increase in the specificity of downstream molecular analyses. With LMPC™ the force of focused laser light is utilized to excise selected cells or large tissue areas from object slides or from living cell culture down to a resolution of individual single cells and subcellular components like organelles or chromosomes, respectively. There is no heat involved, and the applied laser wavelength of 337 nm does not affect the biological information. After microdissection this sample is directly catapulted into an appropriate collection device. As this process works entirely without any mechanical contact, it enables pure sample retrieval from morphologically defined origin without cross contamination. Wherever homogenous samples are required for subsequent analysis of e.g. cell areas, single cells or chromosomes the PALM® MicroBeam system is an indispensable tool.
With the same system laser microinjection of drugs or genetic material into living cells is possible without any involvement of mechanical, chemical or viral components. And even the catapulting of living cells for subsequent cultivation or cloning has been demonstrated.
Optical Tweezers are also an interesting tool using only the force of focused laser light. In this case microscopically small specimen are trapped and moved in liquid surroundings using a continuous wave near infrared laser at 1064 nm. Optical Tweezers are mainly used for cell sorting, but also for measuring forces of cellular interactions or intracellular activities *in vivo* but also for *in vitro* experiments measuring the forces of molecular mechanism like motion of motor molecules or DNA-transcription. Both systems can be used simultaneously and even together with fluorescence illumination.
The integration of image analysis platforms fully automates screening, identification and finally subsequent high-throughput sample handling. These samples can be directly linked into versatile downstream applications, such as single cell mRNA-extraction, different PCR methods or microarray techniques. Acceleration in sample generation vastly increases the throughput in molecular laboratories and leads to an increasing knowledge about differentially regulated mRNAs and expressed proteins providing new insights into cellular mechanisms and therefore enabling the development of systems for early tumor detection, therapeutic targeting and/or patient-tailored therapy.

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