The recognition of biological cells utilizing Quantitative Phase microscopy system.

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Single ion bombardment of biological cells using an ion microprobe is a promising technique. However, for microprobe investigations of biological processes at a cellular level the precise recognition of a single cell is required. Moreover, cells must be examined in their natural state and environment, i.e. without previously being killed, preferentially not fixed and not stained, and also the use of ultraviolet light for cells observation should be avoided. Additionally, in order to obtain statistically significant results of irradiation, the possibility of fast, automatic recognition of thousands cells (with possible determination of their nuclei) must be provided.

As the computer recognition strongly depends on a quality of an image, the optical imaging system is of crucial importance. For this purpose one of the best solutions could be Quantitative Phase microscopy [1] (QPm) technique. QPm is the recent digital technique of phase contrast microscopy, providing quantitative phase and intensity data obtained from a series of defocused images. The following phase contrast modalities may be generated digitally from the computed QPm phase data with a greater degree of flexibility: Pure phase images (intensity-free), Standard Phase Contrast (Zernike Phase Contrast), Differential Interference Contrast (DIC), Hoffman Modulation Contrast, and Simulated Darkfield.

The advantages of QPm based on the optical upright microscope (in our case Olympus BX51) are unique ability to provide quantitative phase and intensity data independently of each other, specialized phase contrast optics are not required, utilizing conventional brightfield optics. As a result, living biological cells can be examined with sharp clarity of minute specimen detail.

In the poster the general principles of QPm system and several selected cases demonstrating its performance with corresponding pattern recognition examples are presented.

[1] E.D. Barone-Nugent, A. Barty, K.A. Nugent, Quantitative phase-amplitude microscopy I: optical microscopy. *J. Microscopy*, Vol. **206** (2002) 194–203.