Cellular membrane dynamics evoked by femtosecond laser

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Near-infrared (NIR) femtosecond lasers have been used in wide fields of biomedical research, such as gene transfection, intracellular Ca^{2+} wave generation and for inducing action potentials in neurons [1-3]. Although these applications are now emerging, current understanding of the biological response to intense femtosecond laser light is still limited.

Here, cellular dynamics evoked by NIR femtosecond laser in living non-excitable human cancer cells are investigated. When the laser was focused in the cellular cytoplasm, the cellular membrane potential showed clear hyperpolarization (Fig. 1 a). When the laser was focused on the outer plasma membrane, the membrane potential showed depolarization and subsequent repolarization (Fig. 1 b). Interestingly, only in the case when the laser is focused in cellular cytoplasm, changes in membrane potential follows intracellular Ca^{2+} dynamics, which indicates that the laser induced response was biological, and was mediated by Ca^{2+} activated K^+ channel opening. These results entail the first quantitative analysis of laser induced membrane potential modification, which will help to clarify cellular responses under high intensity laser light, and will be useful for biological applications using laser light.

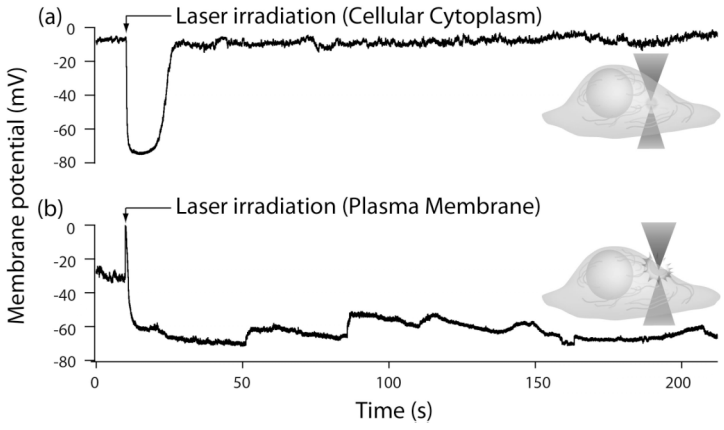

Figure 1 Photogeneration of membrane potential hyperpolarization and depolarization in non-excitable cells, evoked by laser illumination (a) in cytoplasm and (b) on membrane.

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