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The optical syringe for selective differentiation of pluripotent stem cells

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<p>Due to their self-renewal and pluripotency characteristics, stem cells possess the potential to dramatically advance current therapies in tissue regeneration and engineering. Nonetheless, there still remains a pressing necessity to answer the biological questions concerning how stem cell renewal and differentiation programs are operated and regulated at the genetic level. Genetic manipulation such as delivery of exogenous gene expression or knockout with small interfering RNA (siRNA) is relatively rare in mouse embryonic stem (ES) cells. However, genetic species can be selectively introduced and subsequently expressed in live mammalian cells via optical systems, a technique normally referred to as photo-transfection. During photo-transfection, localized application of femtosecond (fs) laser pulses onto the cell plasma membrane induces transient submicrometer holes, thereby facilitating cytosolic uptake of extracellular exogenous materials. This novel optical cell transfection technique allows targeted treatment of cells promoting limited use of reagents or chemicals that can cause spontaneous differentiation and also interfere with the physiological properties of ES cells. In this work, we report for the first time that fs laser pulses can be utilized as an optical syringe for successful transient photo-transfection and induced differentiation of mouse ES cell colonies. This was achieved by using a tightly focused titanium sapphire laser beam spot (1.1 μm diameter spot size, 790nm, 80MHz, 200fs and 50 mW average power output), where E14g2a cells were differentiated into the extraembryonic endoderm via photo-transfection with the Gata-6 transcription factor.

Level (Hons, MSc,
   PhD, other)?

Senior Scientist

Consider for a student
   award (Yes / No)?

No

Would you like to
 submit a short paper
 for the Conference
 Proceedings (Yes / No)?

Yes

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