The influence of femtosecond laser pulse wavelength on embryonic stem cell differentiation

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ABSTRACT

Stem cells are rich in proteins, carbohydrates, deoxyribonucleic acid (DNA), ribonucleic acid (RNA) and various other cellular components which are responsible for a diversity of functions. Mostly the building blocks of these intracellular entities play an active role in absorbing ultra-violet (UV) and visible light sources. Light-matter interactions in biomaterials are a complex situation and subsequent damage may not always amount only from wavelength dependent effects but may also be driven by a wealth of other optical parameters which may lead to a variety photochemical reactions. Previously, literature has reported efficient photo-transfection and differentiation of pluripotent stem cells via near infrared (NIR) femtosecond (fs) laser pulses with minimum compromise to their viability. Therefore, in this study the influence of using different fs laser wavelengths on optical stem cell transfection and differentiation is investigated. A potassium titanyl phosphate (KTP) crystal was employed in frequency doubling a 1064 nm fs laser beam. The newly generated 532 nm fs pulsed beam was then utilized for the first time in transient photo-transfection of ES-E14TG2a mouse embryonic stem (mES) cells. Compared to using 1064 nm fs pulses which non-invasively introduce plasmid DNA and other macromolecules into mES cells, our results showed a significant decline in the photo-transfection efficiency following transfecting with a pulsed fs visible green beam.