

MICROFLUIDIC SYSTEM FOR CELL TRANSFECTION USING SONOPORATION AND ULTRASONIC PARTICLE MANIPULATION

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Abstract

Studies into sonoporation have grown rapidly in biotechnology and medicine in recent years. The use of sonoporation in biotechnology and medicine has potential for enhancing and targeting administration of drugs genes and other therapeutic compounds into the cells. Sonoporation has demonstrated to facilitate efficient gene transfer both in vitro and in vivo. This paper presents a microfluidic system for cells transfection using sonoporation and ultrasonic particle manipulation. The paper presents a theoretical analysis used to design the sonoporation chamber, whilst also enabling ultrasonic particle manipulation using an ultrasonic standing wave. Both the sonoporation and the particle manipulation are achieved using the same piezoelectric transducer (PZT 26) mounted on the micro chamber. The theoretical analysis is based on upon the model for an acoustic particle separator. The resulting design has been implemented in Macor ceramic glass assembly with a chamber size of 6 mm diameter and 750µm thickness. The efficiency of the sonoporation system was determined experimentally by the use of HeLa cells and propidium dye. The transfection rate was determined under a range of sonoporation conditions. The optimal sonoporation parameters will vary depending upon the cell type and purpose. For example, sonoporation typically utilises ultrasonic frequencies of 1 to 3MHz for gene delivery and drug delivery. The experiment results showed a peak cell transfection efficiency of 52.2% at 1.17MHz at 80 Vp-p.