A Novel Capillary Gun for Ballistic Delivery of Microscopic Particles into Tissue and Cultured Cells

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BACKGROUND

The instrument is a pneumatic capillary gun (Fig. 1) and its operation is based on the ballistic delivery of microparticles, the same technique as used in the “gene guns” (e.g., the commercial Helios™ by BioRad). The ballistic delivery of microparticles has the distinct advantages of no need of extrageneous genes or protein for carrier, and can be applied to a wide range of cell types and tissues.

The existing gene gun models were essentially developed nearly 20 years ago and have drawbacks that limit the range of their applications. They are usually hand-held (or even bigger) and do not fit into small opening. The particles cover large areas; their penetration depths are widely dispersed and the accuracy and reproducibility of the delivery are generally rather low. Most importantly, the jet of the high speed Helium used for ballistic delivery can be damaging for the target tissue.

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TECHNOLOGY DESCRIPTION

The advanced capillary gun overcomes the shortcomings of the existing gene gun models. The essential novel design element (Fig. 1a) is usage of active vacuum suction that allows complete diversion of continuous high speed flow of Helium away from the gun nozzle, and it offers the following superior performances:

- *Absolutely no tissue damage*;
- Particles are delivered to a well defined region confined in three dimensions;
- The targeted region usually is comprised from a few to a few dozens of cells, lying at a well defined depth;
- Superior delivery accuracy and reproducibility;
- The capillary gun can be easily mounted on a micromanipulator (Fig. 1b), with a guiding laser beam (Fig. 1c) for a surgical precision delivery.

APPLICATIONS

The instrument has a unique capability to deliver chemicals to a small number of cells in a well defined 3D region without causing damage to the tissue, which is not provided by any existing technique. With some automation, patterns of staining and gene expression can be “engraved” point-by-point in an array of cultured cells, a tissue or an embryo, without any direct physical contact between the capillary gun and the cells. Potential applications include:

- Localized, high spatial resolution staining of tissues with a possibility to stain nearby areas with different dyes.
- Localized transfection and RNA-interference in tissues and embryos with a possibility to engrave spatial patterns of gene expression or gene silencing.
- Touch-free localized transfection and staining of arrays of cultured cells, with a possibility to transfect different areas with different genes.

STATE OF DEVELOPMENT

A robust prototype has been extensively tested and used in experiments. In collaboration with two neurobiology groups at UCSD we have carried out successful assays on staining and transfection of cultured cells, worm embryos and mammalian brain tissue using 1.2 mm gold particles coated with dyes and plasmids. The bombardment of the tissue with the particles did not have any adverse effect on the cells in the

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OTHER INFORMATION

KEYWORDS
capillary gun, gene gun, genetic modification, tissue staining, transfection

CATEGORIZED AS
- Medical
  - Devices

RELATED CASES
2004-207-0

targeted area and on the animal as a whole. The assays have been robust and highly reproducible, and are now an integral part of 3 separate research projects in these groups.

RELATED MATERIALS

- Shefi O, Simonnet, C, Groisman, A, Macagn, E.R. Localized RNAi and Ectopic Gene Expression in the Medicinal Leech JOVE published April 17, 2008. doi: 10.3791/697 http://www.jove.com/index/details.stp?id=697
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PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,892,836	02/22/2011	2004-207

Additional Patent Pending

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