A NEW PROGRAMMABLE 3-AXIS PIEZOELECTRIC NANOMANIPULATOR WITH ULTRA-LOW DRIFT FOR CELLS TECHNOLOGIES

Description

Robotic micromanipulators are used for demanding biotech applications such as Patch Clamp (holding and positioning a cell), IVF (in-vitro fertilization), and cell cloning, as well as in the semiconductor integrated circuits industry – all growing markets. LILEYA's PSF-3 IVF is a state-of-the-art 3-axis nanomanipulator system based on advanced piezoelectric rotary motor, integrated with a digital signal processor (DSP) multifunctional programmable controller including 46 operations. When the motor is deenergized, it provides an automatic solid brake on movement, with almost undetectable backlash and drift. It works by converting the rotary motion of an advanced piezoelectric motor (fitted onto each axis of the nanomanipulator) into linear motion. A combination of high torque, variable speed and high angular resolution enables the piezoelectric motor to be used in either continuous or stepper mode. These characteristics facilitate a smooth transition, without degradation in intrinsic performance, from an angular step of less than 5 μrad to continuous motion, and a range of angular velocities, from 5 μrad/sec up to 60 rev/min. This translates into a linear resolution of 0.4 nm and a linear range of velocities from 0.4 nm/sec to 500 μm/sec for each axis of the PSF-3IVF. Additional benefits of the PSF-3 IVF design include the elimination of heat dissipation, the use of nonferrous and nonmagnetic components, ultra-low electrical noise and lowsupply voltage (12 VDC), which together make the PSF-3 IVF ideal for very sensitive applications.

Innovative Aspect and Main Advantages

PSF-3 IVF combines extremely high resolution (0.4 nm), long term stability (drift less than 2 nm/hour @ 20°C) and long travel (10 mm). The "Stick/Slip" is one of the major factors, which limits nanometer resolution and hence the performance of traditional nanopositioners/manipulators. The PSF-3 IVF overcomes the stick/slip effect using the unique combination of the piezoelectric motor and DSP control. Any angular position of the rotor is locked by the selfdecelerating torque of the motor. The same force locks the whole friction system of the nanomanipulator. To limit the effect of any jump when initiating motion the unlocking process must occur almost instantaneously (within 10-100μsec). PSF-3 IVF's DSP core has been designed to implement a step formation within 2-10 μsec/μrad. This timing results in an angular step of the motor in the nanometer range, which translates immediately into an equivalent linear step eliminating measurable static friction effects.

Areas of Application

LILEYA's advanced Nano-Manipulator technology is designed to meet a variety of positioning needs for the scientific, biotechnology, medical, semiconductor and industrial markets. It is suitable for applications such as: patch clamp experiments on cells in culture, microinjection into cells, cell imaging, cellular and material handling, IVF fertilization and sterility treatments, DNA cloning experiments, extracellular recording, intracellular recording, cytopathology, precision robotic applications, MRI-guided robotic surgery applications, integrated circuits applications, IC mask generation and alignment, IC lithography, IC wafer measurements, fiber optic assembly and alignment, laser production, E-beam control for IC's, ion beam control for IC's, read-write heads for recording tape and CD's, storage media applications.

Fig.1 SOFTWARE PSF-3 IVF

Fig. 2 Nanomanipoulator PSF-3 IVF

Fig. 3 Nanomanipulator PSF-3 IVF –H

Stage of Development

LILEYA's unique designs are protected by:

- United States Patent "MICROMANIPULATOR" , Application Serial No.#2005/0023930
- Russia Patent "MICROMANIPULATOR" No.2041480
- UA Patent "MICROMANIPULATOR" No.2002064866

LILEYA builds systems with superior high performance characteristics and it can produce 50-100 systems in years at a low cost.

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Technology Reference

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