

Development of Impact Drive Mechanism

Outline

Impact Drive Mechanism (IDM) moves with nm to μm steps by utilizing rapid deformations of Piezoelectric actuator (Piezo).

Principle of movement

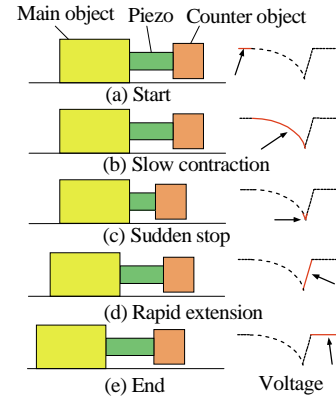
- (1) Piezo is extended at the beginning of cycle.
- (2) Main object is stationary during Piezo is contracted with a constant acceleration because of a static frictional force.
- (3) The contract of Piezo is sudden stopped. The device get momentum like a collision so that it starts to move leftward.
- (4) As soon as Step (3) is completed, Piezo is extended steeply. The generated inertial force is much larger than the static friction.
- (5) The whole device moves leftward further until it loses the kinetic energy.

Rightward movement can be obtained by changing the extension and contraction of Piezo.

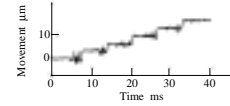
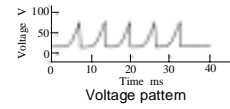
Results

In general, mechanisms utilizing impulsive force are used only on a dry surface without lubricant to get larger friction. We found that IDM can move on a lubricated surface and even in oil. Lubricant helps stability of movement and decrease undesirable vibration.

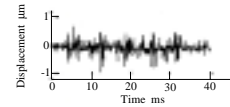
IDM is studied with Prof. Toshiro Higuchi of the University of Tokyo, who is a inventor of IDM.



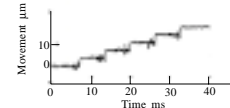
Principle of movement



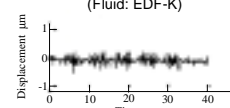
Movement in horizontal direction on dry base



Displacement in vertical direction on dry base

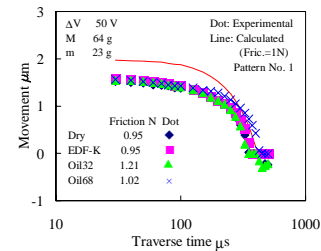


Movement in horizontal direction on wet base (Fluid: EDF-K)

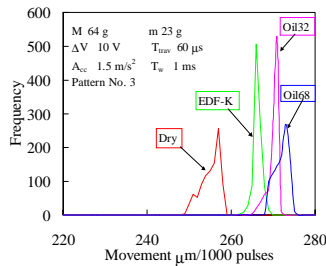


Displacement in vertical direction on wet base (Fluid: EDF-K)

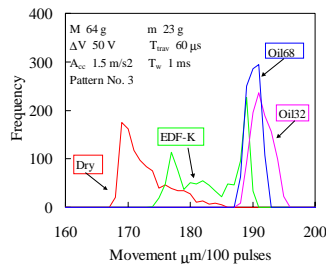
Examples of movement



Movement vs. traverse time

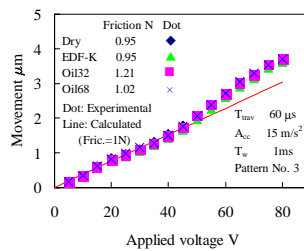


Medium step

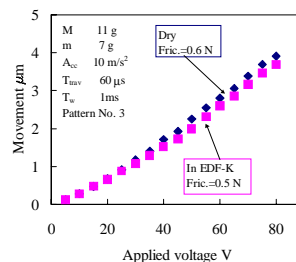


Coarse step

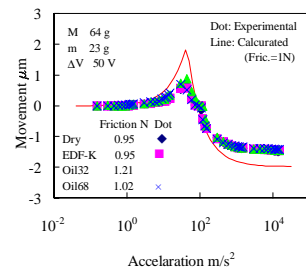
Distribution of movement



Movement vs. applied voltage



Movement in viscous fluid



Movement vs. acceleration