NED -
Nanoscopic electrostatic drive

NED glued on printed circuit board with wirebonds & bondlands

NED is a MEMS transducer principle. A beam-shaped actuator consists of at least two electrodes, which are electrically separated from each other by gaps of 2.5 µm down to a few 10 nm. By applying a control voltage, an electrostatic field is generated between these electrodes, resulting in large attractive forces between the electrodes. Suitable geometries of the electrodes in turn transform these forces into lateral forces thus bending the actuators.

The benefits of the NED actuators comprise: #1 Low power consumption ⇨ low capacitance, small reactive currents and low control voltages enable the use of energy-efficient driver circuits and thus result in low power consumption of the overall system. #2 CMOS compatibility ⇨ integration of actuators with CMOS circuits, RoHS compatibility. #3 High number of degrees of freedom ⇨ beam shape or plate, either deflection direction or combination, translation or tilting movement, cascading serially and/or parallel to increase deflection and/or forces or both.

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Bending actuators configurations

Single entity examples

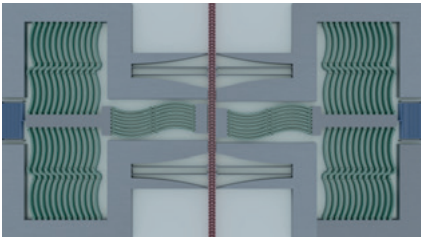| Direction/type	Unit	Out-of-plane (vertical)	In-plane (lateral)
Travel	µm	1	100
Dimension	µm	60 x 4000 x 30	6 x 2000 x 10
Force	µN	1.6	1.6
Voltage	V	90	60

System examples

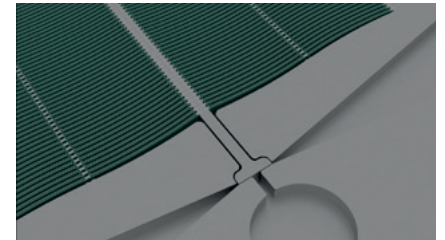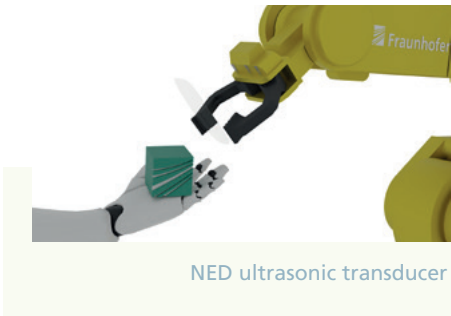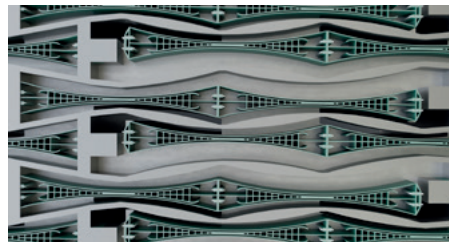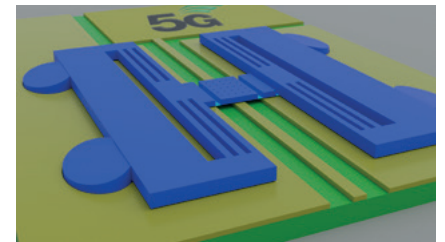| Direction/type	Unit	Out-of-plane (vertical)	In-plane (lateral)
Travel	µm	> 200	> 500
Dimension	µm	7023 x 3605 x 25	2500 x 1600
Force	µN	> 100	> 3500
Voltage	V	1 … 250	2.5…300

Applications

NED based step drive
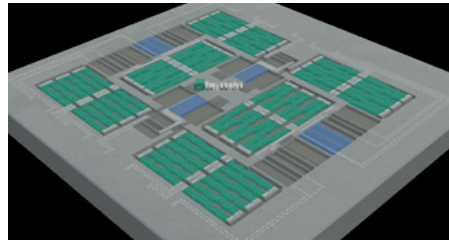
NED 2D micromotors

NED microfluidic valves

NED ultrasonic transducer

NED speaker

NED RF MEMS varactor

Classification

	Lateral deflecting	Combination lateral + vertical	Vertical deflecting
NED BENDING BEAM ACTUATORS			
	One side clamped Two side clamped	One side clamped Two side clamped	One side clamped Two side clamped
	Stacking parallel (force)		Stacking parallel (force)
	Stacking serial (deflection)		Stacking serial (deflection)
	Bulk micromachined	Bulk micromachined	Bulk micromachined
			Surface micromachined

Versatility

Specific adaption for various applications possible. Limited examples available from premanufacturing.
User specific fabrication upon request.