Philips' fluid Lenses Bring Things into Focus; Unique Variable-Focus With No Mechanical Moving Parts

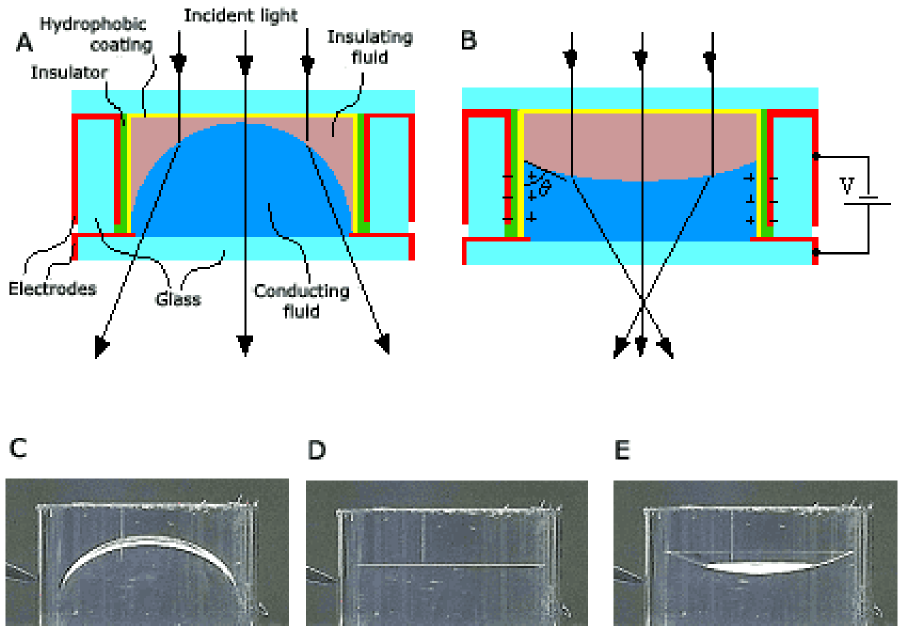
July 3 2004

Philips Research has demonstrated **a unique variable-focus lens system that has no mechanical moving parts**. Suited to a wide range of optical imaging applications, including such things as digital cameras, camera phones, endoscopes, home security systems and optical storage drives, Philips' FluidFocus system mimics the action of the human eye using a fluid lens that alters its focal length by changing its shape. **The new lens, which lends itself to high volume manufacturing, overcomes the fixed-focus disadvantages of many of today's low-cost imaging systems**.

The Philips FluidFocus lens consists of two immiscible (non-mixing) fluids of different refractive index (optical properties), one an electrically conducting aqueous solution and the other an electrically non-conducting oil, contained in a short tube with transparent end caps. The internal surfaces of the tube wall and one of its end caps are coated with a hydrophobic (water-repellent) coating that causes the aqueous solution to form itself into a hemispherical mass at the opposite end of the tube, where it acts as a spherically curved lens.

The shape of the lens is adjusted by applying an electric field across the hydrophobic coating such that it becomes less hydrophobic - a process called 'electrowetting' that results from an electrically induced change in surface-tension. As a result of this change in surface-tension the aqueous solution begins to wet the sidewalls of the tube, altering the radius of curvature of the meniscus between the two fluids and hence the focal length of the lens. By increasing the applied electric field the surface of the initially convex lens can be made completely flat (no lens effect) or even concave. As a result it is possible to implement lenses that transition smoothly from being convergent to divergent and back again.

In the FluidFocus technology demonstrator, the fluid lens measures a mere 3 mm in diameter by 2.2 mm in length, making it easy to incorporate into miniature optical pathways. The focal range provided by the demonstrator extends from 5 cm to infinity and it is extremely fast: switching over the full focal range is obtained in less than 10 ms. Controlled by a dc voltage and presenting a capacitive load, the lens consumes virtually zero power, which for battery powered portable applications gives it a real advantage. The durability of the lens is also very high, Philips having already tested the lens with over 1 million focusing operations without loss of optical performance. It also has the potential to be both shock resistant and capable of operating over a wide temperature range, suiting it for mobile applications. Its construction is regarded as compatible with high-volume manufacturing techniques.



(A) Schematic cross section of the FluidFocus lens principle. (B) When a voltage is applied, charges accumulate in the glass wall electrode and opposite charges collect near the solid/liquid interface in the conducting liquid. The resulting electrostatic force lowers the solid/liquid interfacial tension and with that the contact angle θ and hence the focal distance of the lens. (C) to (E) Shapes of a 6-mm diameter lens taken at different applied voltages.

The original press release can be found here.

Citation: Philips' fluid Lenses Bring Things into Focus; Unique Variable-Focus With No Mechanical Moving Parts (2004, July 3) retrieved 4 April 2024 from https://phys.org/news/2004-07-philips-fluid-lenses-focus-unique.html