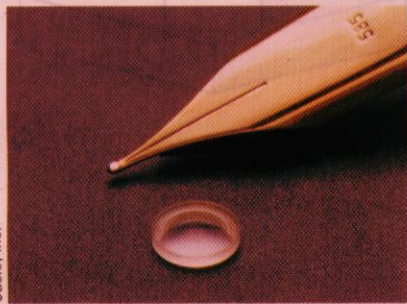


## The Ceramic Camera Lens

For thousands of years, people have molded clay into objects. Ancient pots were turned into ceramic vessels basically the same way we do it today: by firing them at very high temperatures. Firing causes the individual crystal grains of the



**Photo 1—The world's first transparent ceramic lens**

inorganic, nonmetallic minerals to join together in a permanent polycrystalline lattice. In the past, ceramics have been opaque or at best translucent, because polycrystalline lattice has pores where the grains intersect. These pores scatter light. The large pores in earthenware and stoneware make them opaque. The smaller pores in fine china make it translucent.

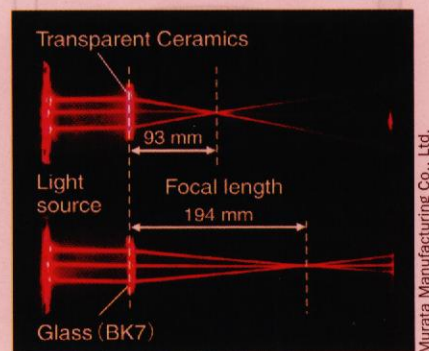
Murata Manufacturing Co., Ltd., has recently developed Lumicera™, a transparent ceramic. The company's manufacturing process optimizes the chemistry and firing processes to increase the density of the polycrystalline lattice, which results in the formation of few pores. Lumicera is stronger than optical glass, can transmit visible and infrared light as well as optical glass, and has a higher refractive index than optical glass.

Casio, Inc., recently announced that it has used its own proprietary optical technology to create the world's first ceramic lens made using Lumicera. (See Photo 1.) The optical properties of this lens will

allow Casio to create smaller-profile zoom camera lenses than those now made using optical glass.

Casio's interest in Lumicera transparent ceramics was sparked by two Lumicera material properties. Lumicera has greater strength than optical glass and the transparent ceramic has a greater refractive index ( $n_d = 2.08$ ) than optical glasses ( $n_d = 1.5 - 1.85$ ). This greater refractive index will allow Casio to manufacture camera lenses that have much smaller profiles. To enhance Lumicera's optical properties, Casio found a way to increase the material's ability to transmit different wavelengths of light. The company also refined Murata Manufacturing's process for creating transparent ceramics that contain no pores. The pores that formed in the transparent material refracted light so they looked like

air bubbles. The appearance of bubble-type imperfections rendered the material unsuitable for lens fabrication. Casio has also developed the appropriate polishing and coating processes needed to turn the base material into superior camera lenses. Figure 1 compares the light-refracting properties of a glass lens to a transparent ceramic lens.



**Fig. 1—Light-refracting properties of glass and transparent ceramic lenses**

The new lenses, with their very

small profiles, will quickly find their way into all the digital devices that people use to take pictures. Casio recently released the EXILIM EX-S100, the world's smallest optical zoom digital camera. It is a 3.2 megapixel camera that has a 2.8 optical ceramic zoom lens and measures 3.46" wide, 2.24" high, and .66" deep. You can learn more about this new technology by typing the term *transparent ceramic lenses* into your favorite search engine.

## Recalling the Facts

1. Why are ceramic objects usually opaque?
2. List two advantages that a Lumicera™ transparent ceramic lens has over an optical glass lens.
3. Why does the refractive index of optical glass or transparent ceramics affect the profile of a manufactured lens? ☞

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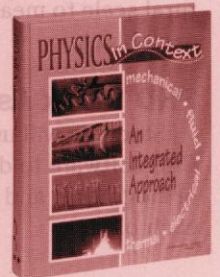
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