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Stressed liquid crystals for fast phase retardation switching[1] ANATOLIY GLUSHCHENKO, KEVIN WOOD, ALEX ROCKWOOD, University of Colorado at Colorado Springs, JOHN WEST, GUOQIANG ZHANG, KE ZHANG, LCI, Kent State University, UCCS TEAM, LCI, KSU TEAM — Liquid crystalline materials are an attractive medium for many devices because they produce large electrically controllable shifts of the phase retardation. Relatively thick (10-100 micron) liquid crystal layers are needed for modern devices. However, the speed of these devices is inversely proportional to the square of the LC layer thickness. We must therefore decouple the speed of switching and thickness of the layer. Here we report on the development of stressed liquid crystals (SLCs) to achieve this goal. These new materials consist of a stressed polymer network that imposes unidirectional alignment of a liquid crystal matrix. We induced the stress by shearing the material. As expected from earlier research in PDLCs, shearing greatly reduces the switching time. Unlike the PDLCs the scattering of the films decreases drastically upon shearing. Indeed the SLC materials are optically clear throughout the visible and infrared. The SLC materials are also characterized by essentially no hysteresis and a completely linear voltage response. This greatly simplifies design of the electronics and driving schemes driving. The SLC's performance is determined by the component materials used, their relative concentration and the preparation conditions. We have produced SLC cells that produce almost 20 microns of phase retardation, that switch on and off in several milliseconds. In general the SLC cells require a driving voltage of about 1V/ μm. The SLCs produce the largest phase retardation at the fastest speeds.

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