Materials for thermo-optically driven adaptive mirrors

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Adaptive mirrors for astronomy require relatively low lateral resolution but a fast response time in the millisecond range. These conditions are perfectly fulfilled with piezo driven systems. For applications in a laser resonator, however, much higher lateral resolution is required whereas the driving speed can be considerably lower. In this case, thermo-optically driven adaptive mirrors are a suitable solution. We report on the materials, the geometry and the preparation of thermo-optically driven adaptive mirrors.

Thermo-optically driven adaptive mirrors can be based on either thermal expansion or thermal dependence of the refractive index (thermal dispersion). The two possibilities are presented. Both use light to modulate the mirror. The thermal expansion based thermo-optically driven adaptive mirror consists of a thin layer of Sylgard (Fig. 1). At its front side a highly reflective coating is applied. The surface modulation is induced by heating selected areas of the Sylgard film. Heating is achieved by imaging a pattern onto the rear side of the film. Without heating, the mirror surface of 24mm diameter has an optical quality of about a quarter wavelength as measured with an interferometer operated at 632nm. Upon heating, surface modulations of 350nm are measured at an irradiated intensity of 370 mW/cm^2 (Fig. 2). Contrast drops to 30% at a resolution of 1.6 line-pairs per millimeter. The response time is below one second. The influence of such an adaptive mirror in a Nd:YAG laser resonator is demonstrated.

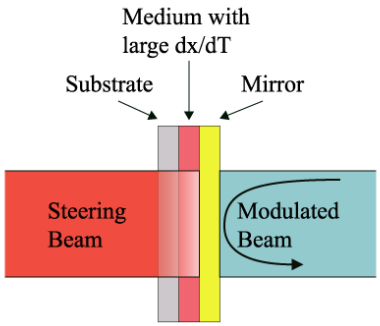

Fig. 1. Arrangement for beam modulation using thermal expansion.

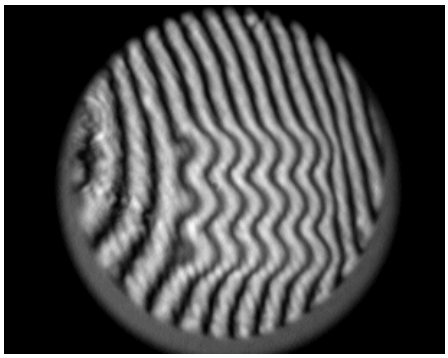

Fig. 2. Interferometric measurement of the surface modulation in a 300µm Sylgard layer on Sapphire.

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