Interferometry and its application in characterizing micro-lenses

Abstract:

Interferometry makes use of the wave superposition principle. When two coherent wavefronts are superposed, an interference pattern, consisted of light and dark fringes, is produced. The interference pattern includes useful information about the interfering wavefronts and the propagation medium. Any change in the interfering wavefronts or their propagation medium, such as the temperature, pressure or wavelength changes, results in a change in the interference pattern. So, analyzing the interference pattern permits extremely accurate measurements.

In the conventional interferometry, like the Twyman-Green and Mach-Zehnder interferometers, an unknown wavefront interferes with a known reference wavefront which is usually a plane wavefront, and so the required interference field is produced. Then, by analyzing the interference pattern, the unknown wavefront is reconstructed. The investigation and optimization of interference pattern analyzing methods increase the reconstruction accuracy of unknown wavefront.

However, providing a known reference wavefront with a good quality is not easy and entails additional optical elements. The reconstruction of two unknown interfering wavefronts, without the need for a reference wave, overcomes these limitations and also provides new applications.

Interferometry permits full characterization of the aberrations of micro-lenses as well as radius of curvature, thickness and focal length measurements. In addition, some of the current applications of optical interferometry are accurate measurements of small displacements, studies of gas flows and plasmas, tests of surface quality, measurements of temperature and pressure, and laser frequency measurements.