ADAPTIVE OPTICS APPLIED TO DEEP 3D METROLOGY

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Optical profiling techniques, mainly confocal and white light interferometry, have demonstrated to be suitable for characterization of transparent thick films. Measurements are carried out by vertically scanning the upper and lower film interfaces. Layer’s thickness and 3D topographies of upper and lower interfaces can be determined from the two peaks of the confocal axial response or from the two sets of interference fringes developed during the vertical scan.

When trying to profile a deep surface the convergence of the light rays together with the refractive index mismatch cause spherical aberration and a shift of the peak position that degrade the performance of the common optical metrological tools [1].

We have checked the performance of both confocal profiling and vertical scanning interferometry techniques for deep metrology [2] and compared with results obtained on air-substrate interfaces. Results reveal that even for few microns thick layers the repeatability of confocal profilers is about one order of magnitude worse than that obtained when no layer is present. VSI results are even worse than confocal ones. Furthermore, the lateral resolution achieved for a confocal profiler is also far better than that of interferometry because the null OPD position is away from the focus. Finally the accuracy of the measurement gets worse with increasing thickness for both technologies but this effect is emphasized when using interferometry.

In order to improve results obtained on profilometry of deep surfaces we propose to take advantage of recent developments in the adaptive optics field and thus use a deformable mirror to compensate the spherical aberration introduced by the sample [3]. We expect this would give us a flexible way to obtain deep 3D metrology with a performance as good as that obtained when profiling an air-substrate interface. We will present optical designs and simulations of wavefronts propagated through the optical setup for confocal profilers and Linnik-type interferometers.