Measurement of thin optical layers by multispectral interferometry

Studiengang: BSc in Micro- and Medical Technology | Vertiefung: Optics - Photonics
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Thin-layer thickness in micro-manufacturing is an important parameter that needs to be measured with nanometric precision. This project aims at determining optical layer thickness using light interference produced at the surfaces of the layer.

Introduction:

The company EV Group develops machinery for semiconductor manufacturing, microsystems and nanotechnology. This project aims at developing an instrument to measure the thickness of an optical layer deposited on a wafer, providing a map of the layer thickness on the entire wafer surface.
Existing instruments allow only for point-to-point measurements resulting in a long time to map the entire surface.
Using each pixel of a color camera as a low-cost spectrometer, it is possible to analyze wide surfaces at one time. Detection by a common industrial camera avoids the use of expensive light detectors and allows data to be transferred directly to the PC.

Goals:

The goals of this project are to realize an instrument capable of measuring the layer thickness on an extended surface and to investigate if it is possible to reach a precision comparable to existents instruments, with an industrial camera. The steps of the project are:

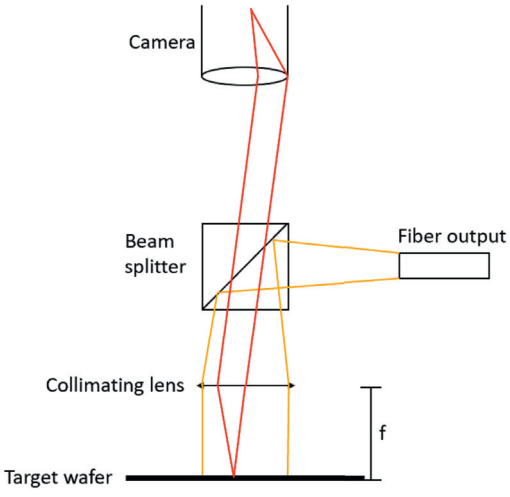
- Realization of the wide field illumination
- Parallelization of the measurement over the whole surface of the wafer
- Test and characterization of the measurement systems
- Documentation

Methods:

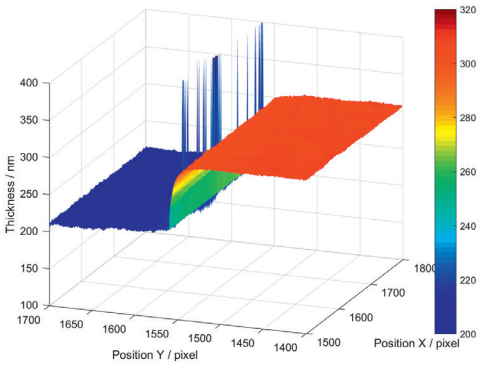
To obtain the thickness of the layer, the degree of reflection of the incident wave on the surface is then measured. The change in degree of reflection is caused by interference between the rays reflected at the surface of the optical layer and those reflected at the interface layer-substrate. The measurement of the wavelength dependent degree of reflection is performed by the three channels (RGB) of very camera pixel. The camera pixels act as pseudo-spectrometer: they allow to have enough information to estimate the layer thickness by an optimization process.

Results:

The developed device reproduces an image of the measured wafer area. Each pixel of this image contains information about the thickness of the layer at that point. With the available optics, the prototype can analyze an area of 1 inch in diameter. The goal of



Schematic overview of the system with illumination path (yellow) and detection path (red).



Measurement on a structured wafer with two layers of thickness 210nm and 306nm.

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