OPTICAL COHERENCE TOMOGRAPHY FOR EXAMINATION OF ART
THE WORKSHOP
3 – 5 JULY 2008, TORUŃ, POLAND
WWW.OCT4ART.EU

POLARISATION-SENSITIVE OPTICAL COHERENCE TOMOGRAPHY: PRINCIPLES AND APPLICATIONS OUTSIDE THE BIOMEDICAL FIELD

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By extending conventional optical coherence tomography (OCT) – for which only the intensity of the backscattered light is recorded – towards polarisation sensitivity, additional contrast is obtained in the depth resolved images of semitransparent materials: polarisation-sensitive OCT (PS-OCT) maps the polarisation state of light reflected from the interior of the sample material[1], thus giving access to additional physical parameters, like birefringence, and enhanced structural information, that is difficult to resolve with other imaging techniques. Measurements of birefringence, of full Stokes vectors and Mueller matrices, the simultaneous determination of intensity, retardation and orientation of optical axes as well as measurements of diattenuation have been reported to date.

We will give a short overview on these different PS-OCT techniques together with their original applications in the biomedical field and focus in the following on alternative applications related to material research and non-destructive testing and evaluation. Starting from conventional time-domain PS-OCT imaging of polymer and composite materials[2], we will demonstrate the potential of PS-OCT combined with ultra-high resolution imaging and *en-face* scanning capabilities.[3] Especially *en-face* scanning, i.e. acquiring an image parallel to the surface at a certain adjustable depth, proves to be useful for a quick evaluation of complicated, planar structures without the need of acquiring full 3D datasets derived from multiple cross-sectional scans. With the extension towards polarisation sensitivity, UHR-birefringence imaging allows depth resolved stress measurements in materials and is exemplified on photoresist mould structures as well as on fibre composites as used in aerospace parts: simultaneous determination of the fibre structure, defects (like cracks and delaminations) and residual stress becomes now feasible in a contact-free and non-destructive way. These applications shall serve as instructive examples of the type and quality of information which is obtainable from standard and advanced PS-OCT methods for future applications in the field of non-destructive art examination.

Acknowledgements: This work has been supported by the Austrian Science Fund FWF (Projects L126-N08 and P19751-N20).

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