Real-time Full-field In-depth Polymer Tomography Using Ultrafast Laser

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Abstract
In this report, we present a use of Time Gated Optical Tomography using femtosecond pulses and non-linear optical time gating for the real-time acquisition of 2D in-depth images of polymers. The method is based on so-called “single-shot non-linear time-gated” imaging which discriminates between early arriving ballistic photons and time-delayed scattered photons in reflection geometry. By selecting the ballistic photons, it becomes possible to obtain a clear image of the internal structures, to follow the ongoing processes and to determine the associated kinetic parameters in the sample as well as to recover the absolute refraction indices of observed structures with precision 10⁻³ and light absorption/scattering coefficients. In this report, next to the demonstration of principle of operation and performance estimation, we will present few examples of contactless non-invasive high throughput imaging (up to 1000 images/second) of processes ongoing in transition zones of interdiffusing polymers and in adhesive joints with a few µm depth resolution.

Keywords: Laser imaging, ballistic photons, non-linear optics, polymers, adhesive joints