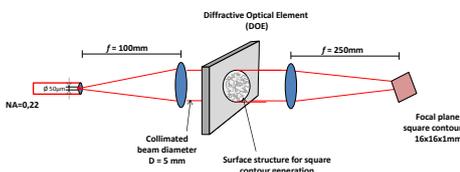


Highlight

Aachen,
February 19, 2013

One-shot laser polymer welding using a diffractive optical element (DOE) for weld contour generation

Figure 1: Beamshaping setup of one-shot laser polymer welding using a diffractive optical element (DOE) and fiber laser radiation (wavelength $1\mu\text{m}$, fiber diameter $50\mu\text{m}$, $\text{NA}=0.22$). The weld contour size in focal plane is a square with dimension of $16 \times 16 \text{ mm}$.



PolyBright's workpackage WP 9 deals with different polymer welding means, characterized by keywords like "Contour", "TWIST", "Mask", "Dynamic Mask", "Quasi-Simultaneous", "Simultaneous", "Remote" and more. Within Task 4.5, simultaneous welding experiments are carried out by VTT and IPG, where the desired weld contour is generated by designing, manufacturing and testing a diffractive optical element (DOE). Welding occurs during ONE single laser pulse with a duration in the millisecond range and laser pulse power of up to 6 kW.

The DOE consists out of a glass element which is coated with a computed "worm-like" surface structure (Leister Technologies AG), causing local phase shifts of a collimated fiber laser beam and resulting in a certain intensity distribution when imaged with the focussing lens (see sketch in Figure 1).

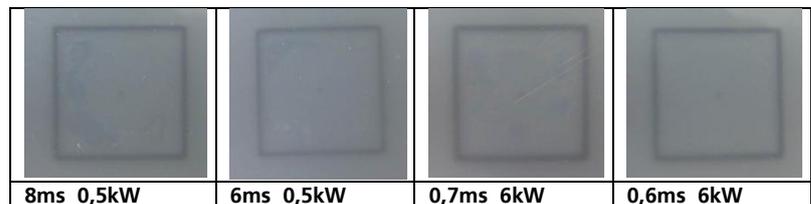


Figure 2: One-shot welded $16 \times 16 \text{ mm}$ square contour of transparent PP 2mm with black PP using a diffractive optical element and $1\mu\text{m}$ fiber laser radiation. Sample position is **in focal plane $z=0$** . Indicated are pulse duration and laser pulse power.

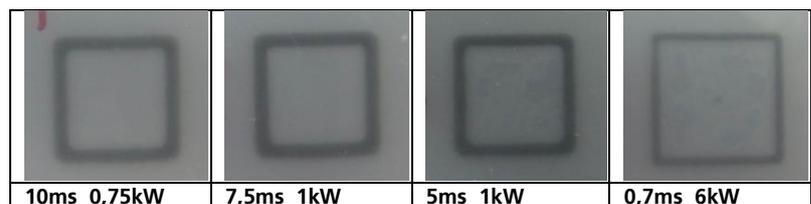


Figure 3: One-shot welded $12 \times 12 \text{ mm}$ square contour of transparent PP 2mm with black PP using a diffractive optical element and $1\mu\text{m}$ fiber laser radiation. Sample position is **above focal plane $z=-15\text{mm}$** . Indicated are pulse duration and laser pulse power.

Experiments are carried out using a pulsed IPG fiber laser, type YLS-600/6000-QCW, welding results see Figure 2 and Figure 3. The fiber laser wavelength is 1030 nm, the DOE for square contour generation is designed by Leister and welding trials were carried out at IPG facilities, welding natural (translucent) as well as carbon black filled Polypropylene PP with 2 mm thickness. Since PP has a semi-crystallite structure, the weld seams in Figure 2 and Figure 3 are not clearly marked, but appear typically blurred due to light scattering.

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