Highlight

Lappeenranta
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Thermal camera imaging for monitoring Quasi-Simultaneous Laser Welding (QSLW) process of polymers

High speed thermal imaging of QSLW process requires a very sensitive thermal camera with high frame rate capacity. These cameras are very expensive and the camera speed correlates with its price. Welding speed also sets the limit for the resolution of the camera. This is a problem if big areas are wanted to be irradiated. We used IR Camera CEDIP TITANIUM 560BB (wavelength range 1.5-5.1µm) which can have up to 10kHz frame rate, but then the resolution is only 32x32 pixels. This is not enough for more than one point measurement. Alternatively, camera can obtain a frame rate of 1 kHz with 320x200 pixels which is sufficient for our purposes. In the trials we used 30x30 mm weld areas for which this resolution was just enough.

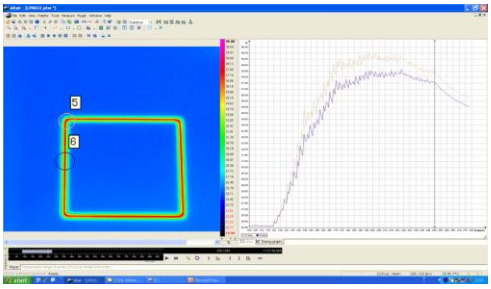

Figure 1: Thermal image of the weld and max temperatures of the two positions on weld **with** IPC

For the tests a 100W fiber laser with f=160mm optic together with LEISTER's M60 diffractive optic was used, which creates a tophat-shaped focal spot with approximately 1 mm diameter. Prejoined 1mm thick polycarbonate samples were used.

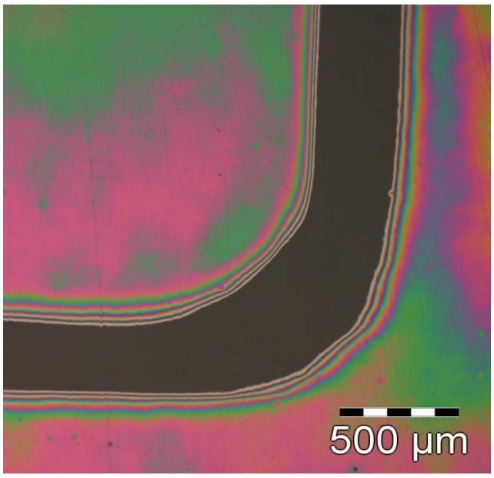

Figure 2: Macrograph of the weld along a corner **with** IPC

Main goal was to verify how Intelligent Power Control (IPC) works and high speed thermal imaging was used to cover the whole weld. The main interest was focussed especially in the corners, since there the laser power was supposed to be lower to match the decreased scanner speed. Figure 1 depicts a whole weld imaged. Parameters used were 10m/s scanning speed with 50 scans. Optimized heating is made with five steps during welding. First 0.1 s laser power is 100 W then the next 0.1 s it is set to 70 W and then next 0.1 s to 50 W and then 40 W and last 0.1 s 30 W. This method just keeps material at molten state longer time when the IPC will help keeping corners cooler. The thermal camera measurements (see Figure 1 and 2) clearly show the five steps of heating and also the cool corners are verified compared to welding without IPC (Figure 3 and 4).

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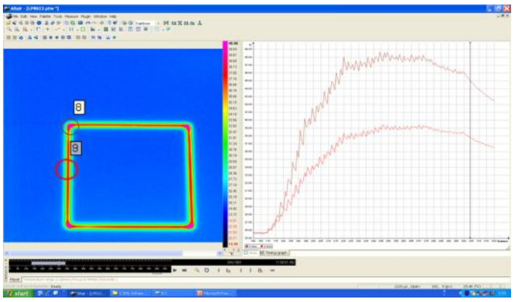

Figure 3: Thermal image of the weld **without** IPC and max temperatures at two positions on weld seam

Thermal imaging speed and resolution might be a challenge in many cases to use it for inline control of the welding process, but in R&D environment high speed thermal imaging has its best applicability. Thermal imaging has also another challenge since polymer plates cannot be pressed together with other material because then thermal radiation is not transmitted anymore. It is also a challenge if the upper polymer plate is thicker than 1 mm since there is not enough radiation to be detected. Below 1 mm thickness the problem is the conducted heat to the material surface which is easily seen by the thermal imaging and it mixes the heat signal after short period of time since surface heat radiation is stronger than the radiation from the joining interface.

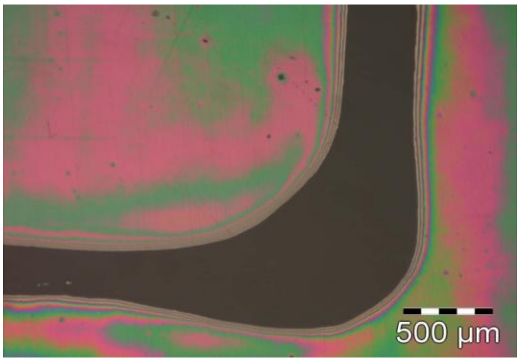

Figure 4: Macrograph of the weld **without** IPC

For any further questions our experts will be pleased to provide you assistance:

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