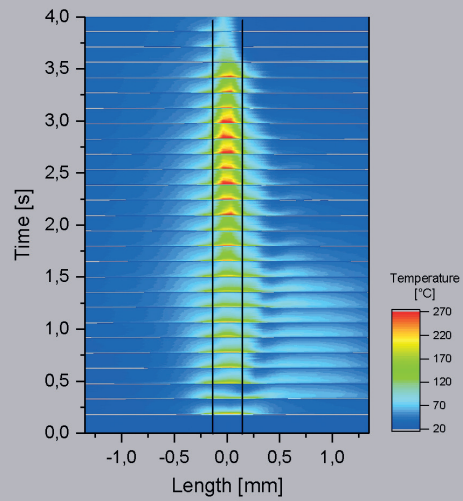


3



4

CUTTING FIBER COMPOSITE MATERIAL WITH HIGH EFFICIENCY AND QUALITY

Task

When lasers are used to cut fiber composite material – in particular, carbon fiber-reinforced plastics (CFRP) – the process design aims to minimize the heat affected zone (HAZ) while maintaining a productive and short processing time. To accomplish this, repeated, fast scanning of the laser beam along the cut path produces successive, gentle material removal. The scanning speed and the cooling time between the scans influence the HAZ and the processing time. Fraunhofer ILT has applied and investigated optimization rules on a demonstrator for the cycle-time-optimized cutting of CFRP and GFRP hybrid materials with a 5 kW single mode laser.

Method

With the aid of thermovideography, the institute analyzed the heating and cooling behavior. Thus, the heat accumulation was quantitatively recorded from scan to scan. For a broad parameter field, the temperature curves were correlated with the resulting HAZ and systematic characteristic curves determined.

Results

Not the fastest possible scan speed, which always delivers the lowest heat input in a single scan, will result in a minimum HAZ, for a given processing time. Rather, optimal scan speeds may be specified where the number of scans required and the duration of the cool down time between scans are adjusted such that reduced heat accumulation results in a minimum HAZ. In this specific case, a HAZ < 50 µm was achieved with unidirectional CFRP cut in the fiber direction.

Applications

The optimization rules developed provide valuable process design support in all applications where glass or carbon fiber-reinforced composite material is cut in a multi-pass process. The heat input is systematically adjusted on the different time scales, within one scan and from scan to scan, for an optimal processing result.

The R&D project underlying this report was commissioned by the German Federal Ministry of Education and Research (BMBF) as part of the »HyBriLight« project under grant number 13N12718.

Contact

Dr. Frank Schneider
Telephone +49 241 8906-426
frank.schneider@ilt.fraunhofer.de

Dr. Dirk Petring
Telephone +49 241 8906-210
dirk.petring@ilt.fraunhofer.de

- 3 Laser-trimmed car roof bow made of a CFK-GFK metal composite.
4 Streak plot of the temperature profile during cutting.