ADVANTAGES AND LIMITATIONS OF LASER TRANSMISSION WELDING FOR HIGH PERFORMANCE COMPOSITES

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ABSTRACT

Due to their superior specific strength and stiffness properties, continuous carbon fibre reinforced thermoplastics (TPC) are becoming more important in many industrial applications. In order to cope with rising production volumes, automatable and flexible production processes, e.g. joining techniques, are desired. Due to its local energy input and its high flexibility, laser transmission welding (LTW) is regarded as an acceptable industrial process for the joining of unreinforced thermoplastics. By enhancing this technology with respect to a realization of a welding process based on continuous carbon fibre reinforcements, the full benefits of welding conventional thermoplastics could be transferred to this novel material category. Hence, the subject of the work presented here is to generate fundamental process knowledge concerning a potential use of TPC as laser absorbing part within the frame of LTW processes. Significant differences to the process characteristics encountered during the joining of unreinforced thermoplastics emerge from the carbon fibre reinforcement, inducing high thermal conductivity and fluctuating absorption properties for the laser wavelength. This results in an essentially altered plastification performance, which is directly mirrored in the weld seam structure. Correspondingly, actions for an enhancement of the process reliability are presented.

1. INTRODUCTION

In order to provide structural elements with high-value technical functions, components of simple geometries have to be joined to create more complex assemblies. In contrast to thermoset composites, for reinforced plastics based on thermoplastic matrix materials (TPC), e.g. polyphenylene sulfide (PPS), polyetherketoneketone (PEKK) or polyetheretherketone (PEEK), a welding connection comes into consideration. Today, different techniques like resistance welding, ultrasonic welding, vibration welding or induction welding are used, revealing respective advantages and disadvantages [1-3]. Besides the manufacturing of pure CFRP components, combinations of reinforced and unreinforced or partially reinforced materials are of interest. Due to a high request for future aircraft interior components, especially thermoplastic brackets, pins and retainers in combination with continuous fibre elements have to be joined. In this context, the laser transmission welding technique could provide an alternative to existing welding methods by transferring the benefits originating from the welding of unreinforced and short glass fibre reinforced injection moulded thermoplastics to this new material combination.