INJECTION OVERMOLDED POLYMER-METAL HYBRID STRUCTURES

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INTRODUCTION

Polymer-metal hybrid (PMH) structures are specially designed and manufactured to bring together the relevant characteristics of each component into a single structure. In this sense, these structures can combine the mechanical strength of metals with the lightness and durability of polymers. They are used in various sectors such as transportation, household appliances, energy and biomedical [1,2]. Metal insert injection over-molding is an important technique for the assembly of polymer-metal hybrid structures [3]. It is based on the injection molding of thermoplastics, an automated process that makes it possible to obtain parts with complex geometries and dimensional precision, in very short molding cycles [4].

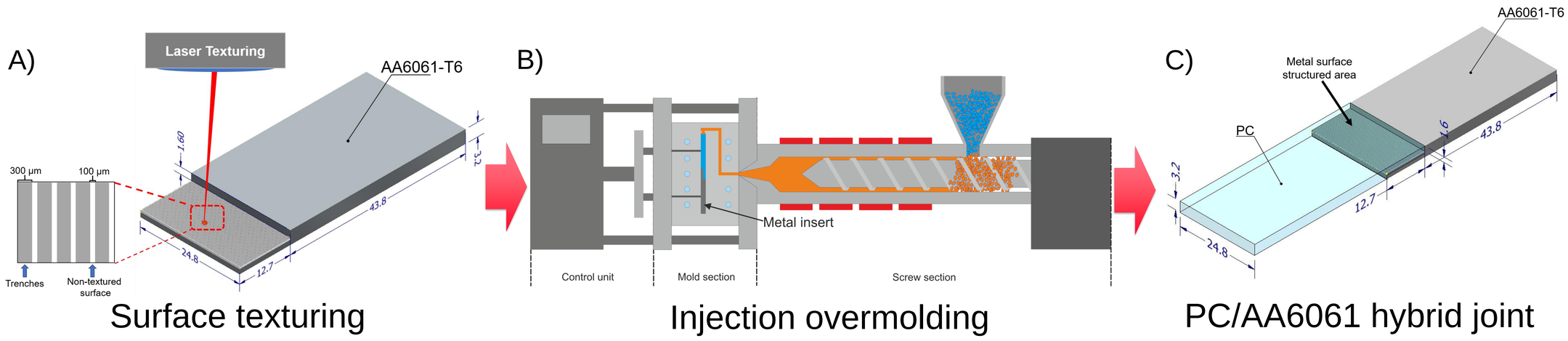

Figure 1: Laser texturing and joining process via injection overmoulding. A) Metal insert and texture dimensions; B) Injection overmoulding process, textured insert positioned inside injection machine mould; C) Dimensions of PC/AlSi10Mg joint

ADVANTAGES

- Polymer-metal hybrid structures joined by fasteners or adhesives show disadvantages compared to directly joined structures, such as stress concentration and long curing time
- Laser texturing technique can create diffferent structures on the metal surface
- Injection molding is a widespread process in the plastics industry due to production of large-scale parts with excelente dimensional control

OBJECTIVES

Investigate the effect of laser micro-structuring (L-MS) on the metal insert surface affecting the lap shear strength of polycarbonate (PC) - aluminum alloy 6061-T6 hybrid joints manufactured by injection overmolding.

RESULTS

Table 1: L-MS conditions used for surface structuring of AA6061 substrates

Condition	Scan speed [mm s^{-1}]	Frequency [kHz]	Number of Scans
C1	250	20	4
C2	500	20	4
C3	500	40	4

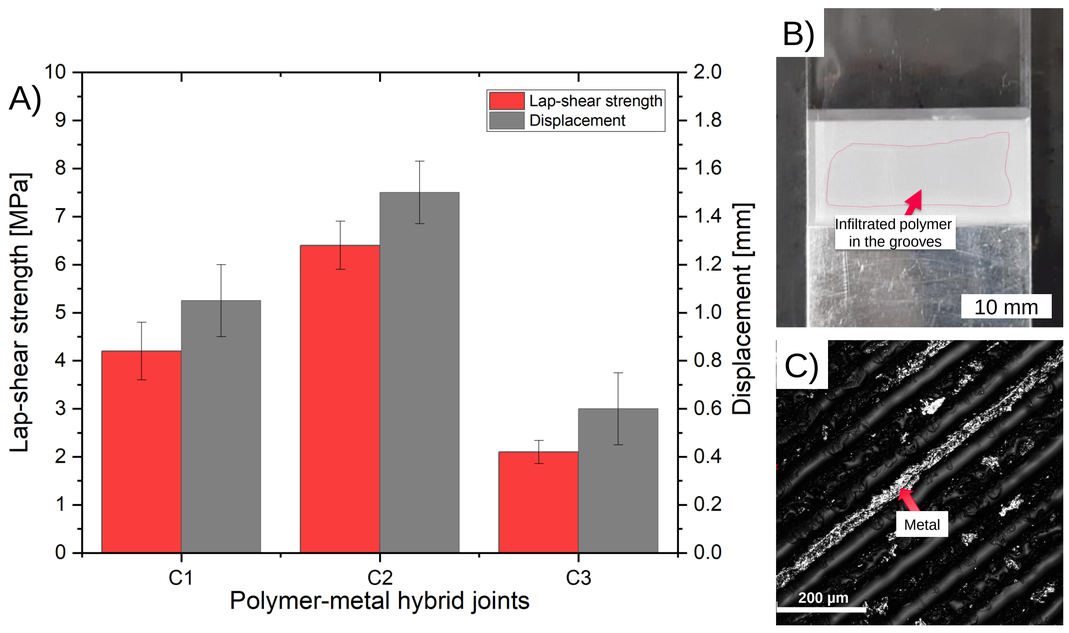

Figure 2: A) lap-shear strength recorded in the lap-shear testing of injection over-molded PC/AA6061 hybrid joints containing laser-structured AA6061 substrates under conditions C1, C2 and C3 (Table 1); B) Top view of the metal-polymer overlap region; C) Laser confocal microscopy image PC/6061-T6 fractured interface.

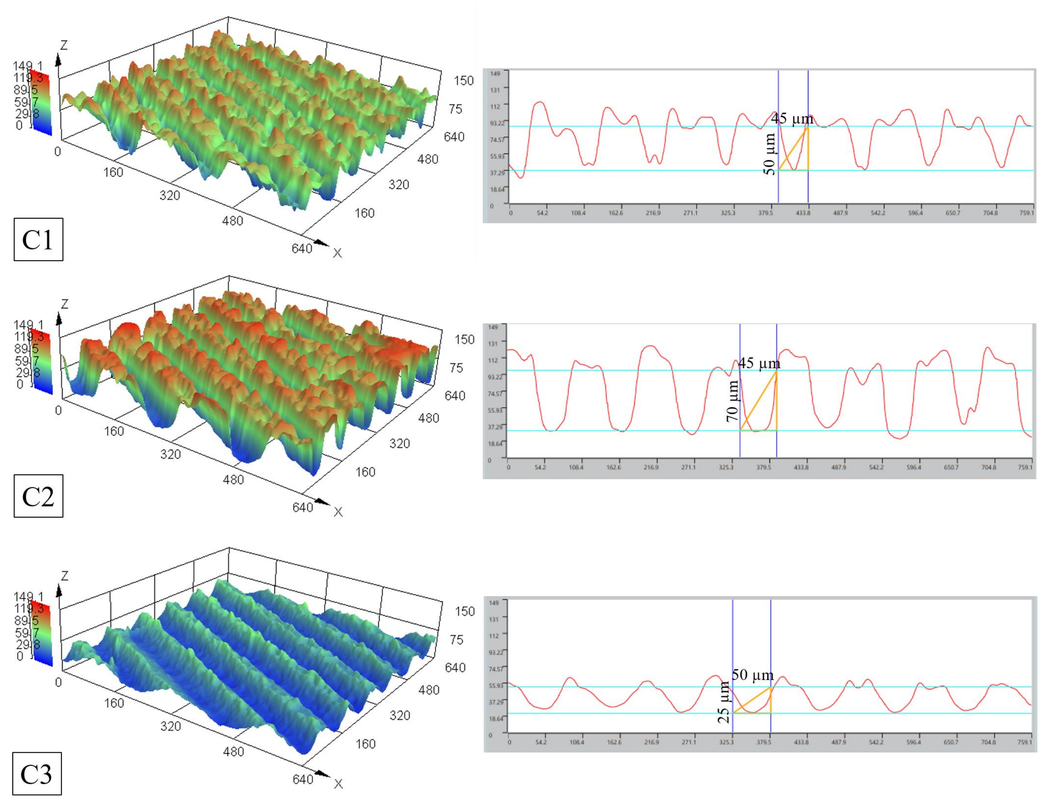

Figure 3: 3D Laser confocal microscopy images and surface profile of the AA6061 substrates structured by laser texturing under following conditions: A) C1; B)C2; C) C3 (Table 1).

CONCLUSIONS

Injection over-molded polycarbonate (PC) with laser surface structured AA6061 alloy hybrid joint with an average shear strength of 6.3 ± 0.3 MPa was obtained, which is an excellent result for this type of hybrid structure. The laser parameters - speed, frequency and number of scans - proved to be relevant for controlling the depth of grooves formed in the metal substrate and, consequently, for the mechanical performance of the PC/AA6061 hybrid joints.

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