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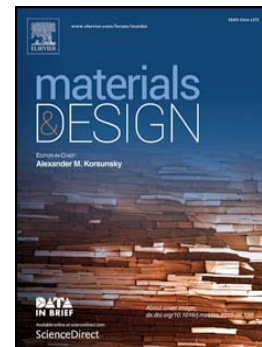
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A.B. Abibe, M. Sônego, J.F. dos Santos, L.B. Canto, S.T. Amancio-Filho

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# ON THE FEASIBILITY OF A FRICTION-BASED STAKING JOINING METHOD FOR POLYMER-METAL HYBRID STRUCTURES

A.B. Abibe <sup>a</sup> – andre.abibe@hzg.de  
M. Sônego <sup>b</sup> – mrl.sonego@gmail.com  
J.F. dos Santos <sup>a</sup> – jorge.dos.santos@hzg.de  
L. B. Canto <sup>b</sup> – leonardo@ufscar.br  
S.T. Amancio-Filho <sup>a, c\*</sup> - sergio.amancio@hzg.de

<sup>a</sup> Helmholtz-Zentrum Geesthacht, Centre for Materials and Coastal Research, Institute of Materials Research, Materials Mechanics, Solid State Joining Processes, Geesthacht, Germany

<sup>b</sup> Graduate Program in Materials Science and Engineering (PPG-CEM), Federal University of São Carlos (UFSCar), São Carlos, SP, Brazil; <sup>c</sup> Hamburg University of Technology, Institute of Polymer Composites, Hamburg, Germany

\*Corresponding author:

Sergio de Traglia Amancio-Filho  
Max-Planck Strasse 1, D-21502 Geesthacht, Germany  
Tel: +49 4152 87 2066  
Fax: +49 4152 87 2033  
sergio.amancio@hzg.de

## ABSTRACT

The increased use of hybrid structures to reduce weight currently faces the limitations of traditional joining methods. Consequently there is a niche for development of new joining techniques, which can reduce or overcome some of the existing limitations. This paper presents for the first time the new Friction-based Injection Clinching Joining technique (F-ICJ), describing the microstructure and changes in local properties of joints between polyetherimide (PEI) and aluminum alloy 6082-T6. A shear layer around the rotating tool composes a polymer thermomechanically affected zone (PTMAZ), which presents pores as a result of evolution of gaseous products. The PTMAZ shows decreases of 8% to 12% in local strength compared to the base material, as measured by microhardness. Ultimate forces of 1419±43 N in lap shear and 430±44 N in cross tensile were achieved for F-ICJ joints. These levels are similar to ultrasonic staking joints of the same material combination, but the hollow design of F-ICJ stakes accounts for improved strength-to-weight ratio (18% in lap shear, 21% in cross tensile). Although the F-ICJ process currently requires longer cycles (7.5 seconds) than state-of-the-art ultrasonic staking (2.8-2.9 seconds), generated results indicate that the F-ICJ process is a competitive staking joining method with potential for improvement.

**KEYWORDS:** processing technologies; staking; polymer-metal structures; hybrid joining; friction joining; polyetherimide

## 1 Introduction

There is an increasing trend to reduce vehicle weight in the transportation industry because of environmental issues such as the requirement to reduce CO<sub>2</sub> emissions [1], and

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