ICSMA19 Metz, France, June 26-July 1, 2022
International Conference on strength of materials

High-temperature mechanical response of Aluminum- In-situ Polymer Derived Ceramic Composite prepared by Friction Stir Processing

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Recently, a new class of material known as polymer derived ceramic reinforced composites with excellent mechanical properties are developed. A five time increase in hardness in Copper and three times increase in strength in Aluminum without the compromise in ductility has been reported. More interestingly, the aluminum based composte is shown to possess high temperature grain stability upto 500 ℃. In the present investigation, an Aluminum based polymer derived ceramic composite is prepared by Friction Stir Processing (FSP) route. The composite is prepared by first incorporating a polymer [Polymethyl hydrosiloxane (PMHS)] as a reinforcement. Later, the polymer gets converted to ceramic during the pyrolysis process. The pyrolysis is a process where polymer transforms to ceramic when heated to high temperatures. The developed composite exhibited a three fold increase in tensile strength with 30% tensile elongation. High temperature mechanical response of the composite is investigated by carrying out tensile test in the temperature range of (100^{o}C-500^{o}C). The results show that the tensile strength of the composite is two times higher than the base metal upto 200 °C. While, tensile ductility of the composite drops significantly above 400 °C. At temperatures up to 200 ^{o}C the fracture progresses through the matrix. This indicates that there is a strong bonding between the ceramic particle and matrix. However, above 400 °C ceramic particles were observed on the fractured surface indicating that the failure is due to weak interface between the particle and matrix.

Keywords: Aluminum, Polymer Derived Ceramics, Friction stir processing, high-temperature mechanical response