Title : Investigation of fracture behavior of Ti-Al laminated composite by bending test

Author(s) : **1.** Phubet Leelaseelatham **Student ID :** 650510375

2. **Student ID :**

3. **Student ID :**

Major : Materials Science

Advisor(s) : **1.** Associate Professor Dr. Chatdanai Boonruang

2.

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ABSTRACT

This research investigates the synergistic effects of electrical spark activation and temperature on the interdiffusion behavior, phase evolution, and mechanical properties of Ti-Al laminated composites. The composites were synthesized via solid-state diffusion bonding in a vacuum environment at temperatures ranging from 600 to 750°C for a duration of 24 hours. Phase identification using X-ray Diffraction (XRD) confirmed the formation of the titanium trialuminide ($TiAl_3$) intermetallic phase at the interface. This finding was substantiated by Energy Dispersive X-ray Spectroscopy (EDS) line-scan analysis, which verified the presence of a continuous $TiAl_3$ layer acting as the primary bonding constituent. Quantitative measurements revealed that the intermetallic layer thickness grew significantly with increasing temperature, adhering to the Arrhenius Equation, which stipulates an exponential increase in the diffusion coefficient relative to temperature. Mechanical characterization through three-point bending tests revealed that spark activation significantly reduced the percentage of interfacial delamination. At 650°C, the spark-activated group achieved a minimum delamination percentage of 32.59%, whereas the non-sparked group exhibited higher delamination percentages in certain conditions. This reduction in delamination directly influenced the Bending Stiffness, with the spark-activated group reaching a peak value of 54.24, representing a substantial increase from the baseline of 3.44 and indicating enhanced structural stability. In conclusion, the electrical spark process effectively improves the mechanical integrity of Ti-Al laminated

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composites, enhancing overall strength and mitigating the risk of delamination-induced failure.

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