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Dissimilar welding of high shear strength $Ti_2SnC/Cu/Ti_6Al_4V$ joint at low temperature

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In this work, as the biotoxicity of vanadium element in TC4 has limited it biomedical applications. Recently, nanolaminate ternary MAX phases (M for early transition metal, A for A-group element, and X for either carbon or nitrogen), combining metal-like and ceramic-like properties are able to restore mechanical damages by crack healing similarly to a biological healing process. In other words, at relatively high temperatures, the outward diffusion of A-element from MAX phases could heal millimeter-sized cracks through the formation of intermediate solid phases resulting from the oxidation of the diffused A-element. Ti_2SnC, as one of MAX phases, was successfully welded to Ti_6Al_4V (TC4) through Cu interlayer in Ar atmosphere at low temperature 750°C during 1h under an applied mechanical pressure 10MPa. Until now, this adopted temperature is lowest in the published diffusion bonding work of MAX phases. The results indicated that the outward diffusion of Sn from Ti_2SnC played a critical role in the chemical composition of joints. With the increasing processing time, Sn atoms migrated and accumulated adjacent to TC4 side as diffusion of Ti into Cu-Sn is effective to decrease the activity of Sn. After 60 mins, the reaction layers consisted of five zones: interleaved β-Cu(Sn) and α-Cu(Sn) zone zone (V), enriched Sn and $CuTi_{0.5}Sn_{0.5}$ intermetallic phase (IV), poor Sn, Ti and rich Cu zone (III), Ti_3Cu_4 intermetallic (II) and β-Ti (Cu) phase (I). Shear test results showed that the average shear strength reached 85.7±10 MPa. Corresponding fractographs indicated that the crack mainly propagated along Ti2SnC substrate adjacent to the bonding zone, accompanied with an intergranular fracture mode.

Biography

Wenbo Yu has completed his PhD from Universite de Poitiers and did Post-doctoral studies in Tsinghua University School of Material Science and Engineering. He has published more than 9 papers in reputed journals. He mainly works on MAX phases and SiCf reinforced composite.

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