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Fabrication and mechanical properties of fiber/metal hybrid nanocomposite laminates at elevated temperature

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Abstract

Fiber/metal composites (FMCs) have attracted much attention over twenty years, especially in aerospace and aeromechanical structures. In addition to their advantages of fiber reinforced composites they also possess superior resistance to cyclic loadings.

The Al/APC-2 hybrid nanocomposite laminates were first fabricated. The Al alloy 2024-T3 thin sheets were treated by chromic acid anodic (CAA) method to achieve perfectly bonding with matrix PEEK eventually.

The average values of received notched strength were affected significantly by stress concentration and high temperature. The modified point stress criterion (PSC) was used. The predicted notched strengths by the modified PSC model were not only precisely validated, but applied at elevated temperatures.

Then, Ti/APC-2 hybrid nanocomposite laminates were fabricated. The nanoparticles SiO_2 were uniformly spread on the interfaces of APC-2. Tensile tests at room and elevated temperatures were conducted to obtain the mechanical properties. To predict and verify the feature of knee point the residual stresses and strains were calculated by simple methods. Adopting the residual stress effect and rule of mixtures, the analytical stress-strain curves at elevated temperature were obtained. Predicted values of ultimate strength are lower than those of the empirical data.

Finally, the tension-tension constant stress amplitude cyclic tests were performed to obtain the S-N curves. In comparison, we found that the longitudinal stiffness of Ti/APC-2 nanocomposite laminates increase about 10%-35% higher than that of Ti/APC-2 laminates, the strength about 5%-15%, and the life about 3-5 times.

Biography

Ming-Hwa R. Jen has completed his Ph.D. at Virginia Tech over 28 years and was Professor at National Sun Yat-Sen University, Dept. of Mechanical Engineering, 1990. He was Dept. Head, 1999, and ASE Co. sponsored Chair Professor, 2011. He has published more than 60 papers in reputed journals and serving as an Editor of J. of Nanotechnology, Hans Publishing Co., since 2010.