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NASA TECH BRIEF

Explosive Bonding of Metal-Matrix Composites

	Titanium	Vanadium	Zirconium	Niobium	Tantalum	Molybdenum	Copper	Iron	Stainless Steel
Aluminum	X	X	X	X	X	X	X		X
Nickel	X	X	X	X	X				
Copper	X	X	X	X	X	X		X	
Iron		X		X	X				
Gold				X	X				
Silver	X			X	X				
Magnesium	X								X

Combinations of Dissimilar Metals Already Successfully Bonded

The problem:

To make sheets of metallic composites, reinforced by unidirectional filaments of high-strength steel or by modular-filament sheets.

The solution:

A novel process, using explosive bonding, produces sheet composites of 1100-0 aluminum alloy (tensile strength, 13,000 lb/in^2) reinforced with wires of AM-335 stainless steel (tensile strength, between 400,000 and 500,000 lb/in^2) having a tensile strength of 67,000 lb/in^2. The tensile strength of an explosive-bonded 2014-T6 aluminum composite, reinforced with a modular-filament sheet of custom 455 stainless steel, is 94,200 lb/in^2; yield strength is 90,400 lb/in^2, elongation is 3.5%, and density is 0.120 lb/in^3. The bonds are excellent metallurgically, no external heat is required, various metals can be bonded, and the process is inexpensive.

How it's done:

Typically an absorber sheet (0.125-in. aluminum of any temper), both surfaces covered with 0.008-in. adhesive paper, is positioned on a steel anvil. Over

(continued overleaf)

it are placed the two matrix sheets having the reinforcing filaments rolled into them; between them are placed standoff spacers. A buffer sheet of 0.125-in. aluminum, its lower side coated with similar adhesive paper, is placed immediately over the matrices. Explosive nitroguanidine, in a cardboard container, covers the buffer sheet; centrally in one end of it is placed an E-90 blasting cap with a tetryl booster. Detonation is electrical.

To prevent longitudinal splits, the buffer sheet should be 3 in. greater in width than the matrices. Similar endwise overlap provides a velocity-stabilization ramp for the explosive and reduces transverse shears. Various problems and their corrective procedures are described, as well as many possible variations.

Notes:

1. The aircraft and shipbuilding industries and all fabricators of high-strength metallic composites may be interested.
2. Requests for further information may be directed to:
   Technical Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B69-10804

Patent status:

No patent action is contemplated by NASA.

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