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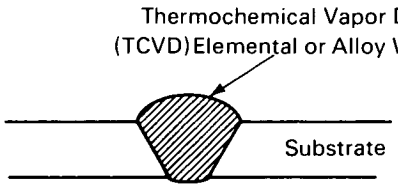
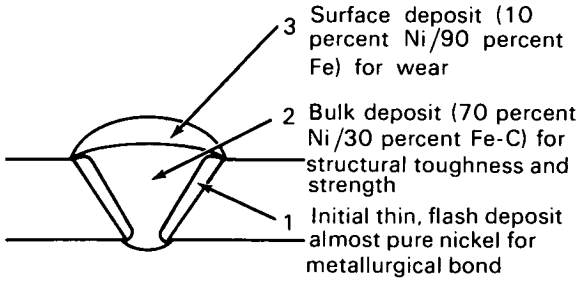
NASA TECH BRIEF

Intermolecular Bonding of Metals or Alloys by Thermochemical Decomposition



Homogeneous Noncomposite Structure



Heterogeneous Noncomposite Structure

The problem:

To bond various metals and alloys at temperatures below their recrystallization temperature.

The solution:

Develop a method where process time for fabricating the joint is short, the joints are as strong as the members being joined, the microthrowing power is good, and the temperatures are below the substrate members' recrystallization temperatures. (Microthrowing power is defined as the ability of the joining material to fill sharp corners and recesses, and to bridge gaps between the members being joined.)

How it's done:

Substrates to be bonded by this method are first formed to the proper shape, chemically cleaned, deoxidized, and coated with a protective metal film. The pieces are placed in a welding jig and a thermocouple is placed near the welding interface. The assembly is then placed in the thermochemical vapor deposition (TCVD) chamber and degassed at 800°F for at least 15 minutes, plated at 800°F for 30 seconds, and then degassed as before. This operation is conducted under maximum vacuum (below 10^{-4} torr). To prevent moisture or oxygen contamination, the substrate surfaces are flushed continuously during both degassing and plating, with a palladium-purified helium/hydrogen gas mixture dried to a dew point of –75° F.

A Ni-Fe-C alloy is then grown by TCVD from organometallic plating compounds to build up a weldment (usually 60 to 90 minutes are required to deposit a thickness of 50 to 100 mils). When the process is complete, the entire plating system is flushed with nitrogen to remove residual plating compounds.

Notes:

1. This information should interest metal fabricators and researchers of welding methods.
2. The following documentation is available from:
   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)

   Reference:
   NASA-CR-80721 (N67-13671), Intermolecular Bonding of Various Metals and Alloys by Thermochemical Vapor Deposition

(continued overleaf)

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Ralph Wilson of
Martin-Marietta
under contract to
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