Arc Spraying Extends Service Life of Composite Structures Tooling

Payoff

Arc spraying is a cost-effective method for extending the service life of tooling used to manufacture composite structures for aircraft. Arc sprayed tooling is more durable than tooling fabricated using conventional methods. The expanded application of arc spraying techniques could lead to substantial reductions in tooling life cycle cost, as well as lower production and prototype costs.

Accomplishment

Scientists and engineers at the Materials and Manufacturing Directorate, the Defense Advanced Research Project Agency (DARPA) and the Boeing Company developed a cost-effective method for extending the service life of tools used to build composite structures for aircraft. The new approach uses arc spraying to fabricate metal faced bond tooling, which is more durable than the tooling manufactured using conventional methods.

Background

Metallic bond tools for complex structures tend to be very costly, heavy and difficult to fabricate whether made from monolithic billets, bump-formed plates, castings or electroformed nickel. While bond tools fabricated from composite systems emerged as the answer to the challenge of fabricating complex contour tooling, the lack of durability of these tools has created the potential for high tool life cycle costs. In harsh production environments, tools fabricated from composite systems tend to require regular rework and repair, and in many cases, need to be remanufactured over the course of long production runs. In 1991, the Boeing Company began investigating the use of arc sprayed metal technology for fabricating bond tools for aircraft composite structures. Using this technology, metal surfaces can be deposited without sacrificing the flexibility required for fabricating complex contoured tooling. In 1995, a cooperative agreement between DARPA and Boeing-St. Louis, was initiated to address the pressing issue of affordability of tools for composite structures. One of the primary objectives of the program, managed by the Directorate's Nonmetallic Materials Division, was to mature arc sprayed tooling techniques. Ultimately, an arc sprayed metal/composite lay-up tool facing sheet technique was developed. This sandwich design of the hybrid facing sheet consisted of a thin layer of arc sprayed metal deposited against a facility tool. Next, a typical composite tooling system facing sheet was collated. Then, a final thin layer of arc sprayed metal was applied to the layup and the facing sheet was cured. Finally, a carbon/epoxy tooling board eggcrate was developed to serve as a support structure. There are five arc sprayed/composite hybrid facing sheet tools, one pylon and four fixed leading edge bond tools in use in the Air Force C-17 production program.