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ELECTRON PROCESSING OF ADVANCED COMPOSITES FOR AEROSPACE APPLICATIONS

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The properties of advanced composites (high strength-to-weight and stiffness-to-weight ratios, corrosion resistance, and excellent wear-, impact-, and damage-tolerances) are making the use of these materials more prevalent within sectors such as the transportation, infrastructure, sporting goods and the military industries. Composites are presently cured using high temperatures and pressures in autoclaves (thermal curing). Thermal curing has several limitations which restrict its versatility and use. These include the need for expensive tooling materials to control the dimensions and shape of composite products during the heating cycle, the introduction of internal stresses within the composite upon thermal cycling, significant waste due to autocuring of prepreg materials, and the use of hazardous chemicals as hardening agents.

Electron (EBeam) curing has several advantages over thermal curing (1). These include the ability to cure at near ambient temperatures, eliminating the need for expensive tooling materials and limiting internal stresses within the product; faster curing rates; stable resins which reduce waste, and; the elimination of toxic agents. The overall result is a process that is more economical and promotes a safer working environment.

Acsion staff have been at the forefront in developing EBeam curing for advanced composites containing epoxy resins (2). Acsion is participating in programs that are geared to establishing EBeam curing as a method for manufacturing composites for aerospace applications and also as a method for repairing damaged composite components on both commercial and military aircraft. The fabrication of cryogenic fuel tanks in cooperation with Lockheed Martin Aeronautics is one example of an EBeam curing program geared to manufacturing. Lockheed Martin and NASA are developing the X-33 reusable launch vehicle (RLV) to demonstrate that cheap, low-risk and routine access to space is possible. The X-33 is intended to be a half-scale forerunner of the Venture Star, the next generation space shuttle. The fuel tanks for the X-33 will hold liquid hydrogen (LH2) and oxygen and will be inside the RLV. Lockheed Martin Aeronautics is interested in using composite LH2 tanks. As part of their development program, Lockheed Martin Aeronautics is working with Acsion to investigate the feasibility of fabricating the composite LH2 tanks using EBeam curing. The fabrication of a one-tenth scale model of the Venture Star LH2 tank is presently underway at Acsion.

Acsion is also developing EBeam curing as a method for repairing composite parts on aircraft. Acsion is conducting repair trials in collaboration with Air Canada (3). At present one trial involving repair of a fairing on the fuselage of an Airbus aircraft has been completed and a second trial is now in progress. Another trial has begun which involves an EBeam repaired engine cowl. Over 700 hours of flight time have been logged and the repaired cowl is performing according to expectations.

Based on the success experienced with commercial aircraft repair, Acsion is proposing to extend EBeam repair to include both existing and future generation military aircraft. The joint strike fighter (JSF) program is a multibillion dollar multinational program lead by the US and the UK to build the next generation of fighter aircraft. The second phase of the program, the $25 B US Engineering and Manufacturing Development (EMD) phase, is scheduled to run for 11 years starting in 2001. As part of the Aerospace Industries Association of Canada (AIAC), Acsion is proposing to provide proprietary repair technologies towards Canada's contribution to this program. If this proposal is adopted by the Canadian Government and leads to a level III participation in the program for Canada, the return to AIAC members is projected to be $70 M worth of work in the EMD phase, rising to $6.2 B in anticipated business in succeeding phases of the program.

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