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NASA TECH BRIEF

Marshall Space Flight Center

Nondestructive Testing of Adhesive Bonds by Nuclear Quadrupole Resonance Method

An investigation was conducted to determine the feasibility of using the nuclear quadrupole resonance (NQR) method for the nondestructive testing of adhesive bonds. Tests were performed with three different polymeric adhesives obtained from commercial sources.

Initial tests on the basic adhesive materials showed that they were incapable of providing an adequate NQR response. Therefore, an inert, strain-sensitive tracer, in the form of cuprous oxide (approximately 1 to 3% by volume), was added to each of the adhesives in order to ensure a sufficiently large signal-to-noise ratio in the NQR system output. Several types of specimens were made with each of the three modified adhesives. The specimens included laminates of glass-fiber reinforced plastic panels, aluminum panels, combinations of these, and plastic and aluminum honeycombs bonded to the panels with the cuprous-oxide modified adhesives.

The results of the investigation showed that the NQR method can be used successfully for the nondestructive testing of the adhesive bonds, provided that rf-transparent structural materials are used between the modified adhesive and the probe of the NQR spectrometer. In general, it was not possible to determine the characteristics of the adhesive bonds in specimens incorporating aluminum structures, as the aluminum is opaque to the rf excitation energy.

Notes:

1. If adhesive bonds in aluminum laminates or honeycomb structures are to be tested by this method, an external probe must be developed in order to bypass the rf energy from the aluminum and permit detection of the NQR tracer responses in the adhesive bonds.
2. The milliwatt energy of the rf waves used in the NQR method has no adverse effect on the plastic structures, their nonmetallic reinforcing components, or the adhesive materials.
3. Any tracer added to the adhesive must be inert to the polymer, have a known NQR response, and be sufficiently strain-sensitive to provide a high signal-to-noise NQR response when the test specimens are subjected to loading (tensile, compressive, etc).
4. Specific technical questions may be directed to:
   Technology Utilization Officer
   Code A&TS-TU
   Marshall Space Flight Center
   Huntsville, Alabama 35812
5. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)

   Reference:
   NASA-CR-61988 (N69-29388), Nondestructive Testing of Adhesive Bonds by the Nuclear Quadrupole Resonance Method

Patent status:

No patent action is contemplated by NASA.

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