INVESTIGATION ON NUCLEAR THERMAL RADIATION EFFECTS ON AIRCRAFT COMPOSITE MATERIALS

J.-J. Serra[1], D. Barreau[2], N. Sonneck-Museux[1], M. Gillet[1]

[1]DGA Aeronautical Systems – Materials & Technologies – High Thermal Fluxes Dpt
10 rue des fours solaires, Odeillo, B.P. 59 – 66121 Font-Romeu Cedex, France
[2] DGA Aeronautical Systems – Materials & Technologies – Airframe Materials & Technologies Dpt
47 Rue Saint-Jean, B.P. 93123 – 31131 Balma Cedex, France

Key words: nuclear weapon, thermal radiation, composite materials, mechanical properties

ABSTRACT

Thermal radiation of high intensity, e.g. caused by the fireball of a nuclear weapon, is a severe threat for aerial vehicles. The behavior of aircraft composite materials exposed to such radiative aggression has been investigated by performing nuclear thermal simulations at the French DGA Solar Facility in Odeillo according to the AEP4 standard.

Three kinds of stratified materials (carbon fiber reinforced polymer/aluminum-resin/paint) were investigated. The samples were exposed to pulses simulating three weapon yields with a constant fluence. Several rectangular test zones were defined in each sample in order to adapt homogeneously exposed zones for subsequent mechanical tests. Recordings of front and back face temperatures were carried out during the pulse and the cooling phase.

These experiments were associated with:

- numerical simulations to compute the temperature field inside the material during and after the exposure ;
- measurement of surface absorptance before and after the tests ;
- non destructive tests to detect flaws appearing at the interfaces between layers ;
- mechanical characterizations to determine the residual properties.

After a description of the test procedures, the present paper analyses the results obtained on measured and computed thermograms, and examines the evolution of different damage markers following the three levels of thermal aggression.