COMPLEX DYNAMIC MODULUS OF NITINOL-REINFORCED COMPOSITES

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ABSTRACT

Shape memory fibers, made of a NIckel-TItanium alloy (NITINOL), are embedded into fiberglass/polyester resin composites in order to control their dynamic characteristics over wide frequency and temperature ranges. The characteristics of the resulting NITINOL-reinforced composites can be tuned and controlled adapt to changes in the loading and operating conditions. Such adaptive characteristics can be utilized in controlling the shape and vibration of composite structures.

The dynamic characteristics of this class of NITINOL-reinforced composites are quantified by measuring the complex dynamic modulus. The modulus is determined using the Dynamic Mechanical Thermal Analyzer (DMTA) over a temperature range from 0 to 100°C and over the frequency range from 0.3 to 30 Hz. The effects of shape memory and initial pre-strain of the NITINOL fibers on the complex modulus are also determined over the same temperature and frequency ranges. The measured characteristics are compared with those of unreinforced fiberglass/polyester resin composites as well as with those of pure NITINOL. It is observed that the continuously decaying storage modulus of the fiberglass composite with increasing temperature, near the glass transition region, can be compensated for by the increased storage modulus of the activated NITINOL fibers. With proper control of the initial pre-strain and activation temperature of the NITINOL fibers, the characteristics of the composite can be tailored for loading and environmental conditions.

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