

NASA TECH BRIEF



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Division, NASA, Code UT, Washington, D.C. 20546.

High-Temperature, Long-Term Drift of Platinum-Rhodium Thermocouples

Thermocouple drift during long-duration use at high temperature can be a serious problem. A thermocouple drift of 55°K at 1500°K in 150 hours has been observed. Such thermoelectric-power changes normally occur with noble-metal thermocouples due to contamination of the thermocouple wire by a change in the amount of lattice defects or by grain growth. An investigation was made in which contamination of the thermocouple wire by impurities was minimized. Pure alumina insulators were used to minimize contamination from this source. A controlled low-impurity-level high-vacuum environment (mean nitrogen equivalent pressure of 3×10^{-8} torr) was used to minimize contamination from the environment.

In the investigation, the average thermal electromotive force change for 87% platinum-13% rhodium/platinum thermocouples was -2.8°K after 3700 hours exposure to a mean temperature of 1530°K . For most engineering applications, a change so minor is negligible. If impurities can be kept from contaminating the thermocouple, thermoelectric-power drift can be held to small values.

Notes:

1. The principles used in this investigation and the results can serve as guidelines for the design and

use of other thermocouple devices requiring a stable thermoelectric power.

2. The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price \$3.00
(or microfiche \$0.65)

Reference:

NASA-TN-D-5287 (N69-29196), Thermal
Electromotive Force Change for 87Pt13Rh/Pt
Thermocouples in 1530°K , 10^{-8} Torr Environ-
ment for 3700 Hours

3. Technical questions may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: TSP70-10552

Patent status:

No patent action is contemplated by NASA.

Source: A. J. Szaniszlo
Lewis Research Center
(LEW-11111)

Category 01,03

NASA TECH BRIEF

THE EFFECT OF TEMPERATURE ON THE MECHANICAL PROPERTIES OF POLYMER-BLENDED COMPOSITES

The mechanical properties of polymer-blenDED composites are highly dependent on the temperature of the material. This is because the polymer matrix undergoes a glass transition, which results in a significant change in its mechanical behavior. The glass transition temperature (T_g) is the temperature at which the polymer chains gain enough thermal energy to overcome the intermolecular forces that hold them in a rigid, ordered state. Above T_g, the polymer chains become more mobile and the material becomes much softer and more ductile. This change in mechanical properties is reflected in the storage modulus (E') and loss modulus (E'') of the material. E' is the real part of the complex modulus and represents the elastic energy stored in the material. E'' is the imaginary part and represents the energy dissipated as heat. Both E' and E'' show a sharp drop at T_g. The drop in E' is much larger than the drop in E'', which is why the material becomes so much softer above T_g. The magnitude of the drop in E' and E'' depends on the type of polymer and the amount of filler present in the composite. In general, the drop in E' is larger for higher modulus polymers and for composites with a higher filler content. The drop in E'' is larger for polymers with a higher loss modulus and for composites with a higher filler content. The temperature dependence of the mechanical properties of polymer-blenDED composites is an important consideration in the design of these materials for use in a wide range of applications. For example, a composite with a high T_g would be suitable for use in high-temperature environments, while a composite with a low T_g would be suitable for use in low-temperature environments. The temperature dependence of the mechanical properties of polymer-blenDED composites is also an important consideration in the design of these materials for use in dynamic environments. For example, a composite with a high T_g would be suitable for use in applications where the material is subjected to high-frequency vibrations, while a composite with a low T_g would be suitable for use in applications where the material is subjected to low-frequency vibrations. The temperature dependence of the mechanical properties of polymer-blenDED composites is a complex phenomenon that is still the subject of ongoing research. However, the basic principles outlined here provide a good starting point for understanding the behavior of these materials.

The authors would like to thank the following individuals for their assistance in the preparation of this paper: [Name], [Name], and [Name]. This work was supported by the National Aeronautics and Space Administration (NASA) under Grant No. [Number].