Elastomer Filled With Single-Wall Carbon Nanotubes

Strength and stiffness increase with SWNT content.

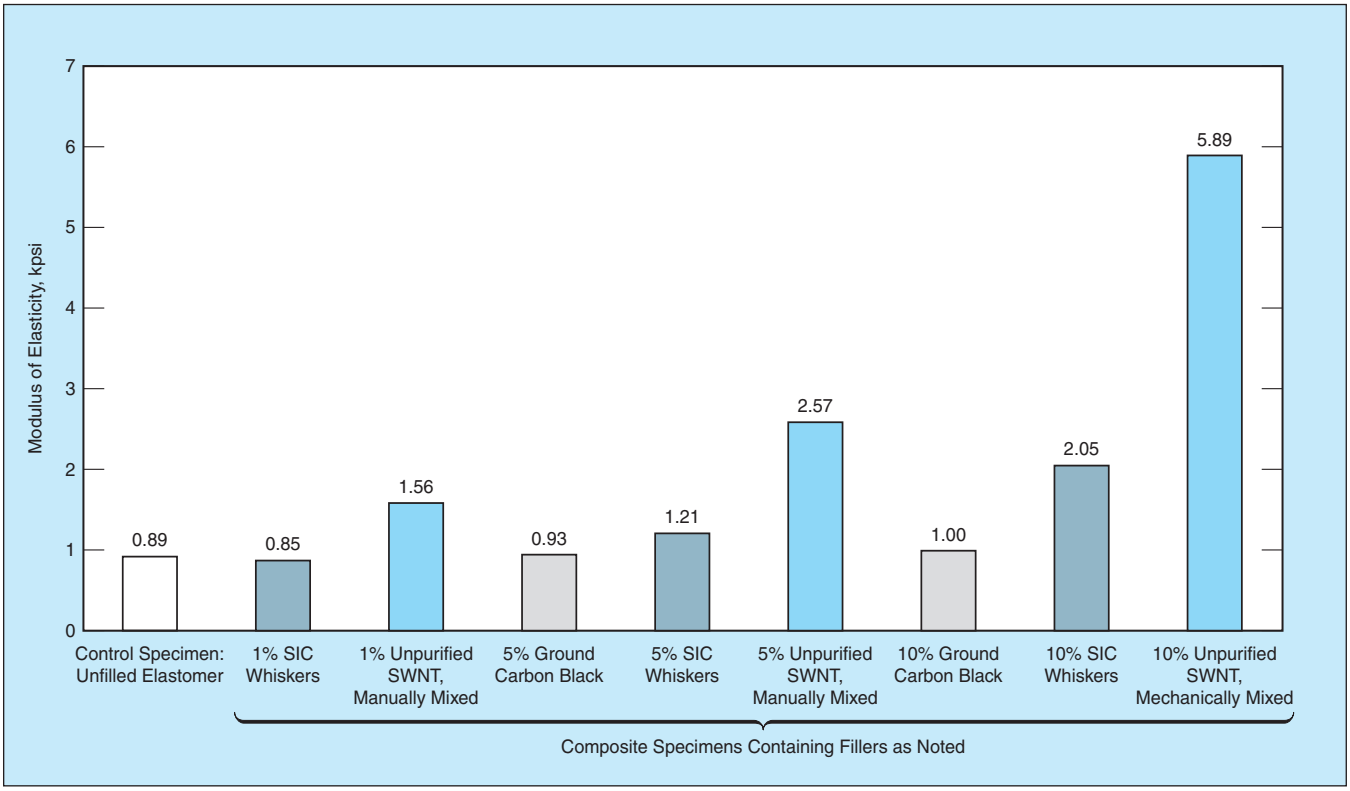
Lyndon B. Johnson Space Center, Houston, Texas

Experiments have shown that composites of a silicone elastomer with single-wall carbon nanotubes (SWNTs) are significantly stronger and stiffer than is the unfilled elastomer. The large strengthening and stiffening effect observed in these experiments stands in contrast to the much smaller strengthening effect observed in related prior efforts to reinforce epoxies with SWNTs and to reinforce a variety of polymers with multiple-wall carbon nanotubes (MWNTs). The relative largeness of the effect in the case of the silicone-elastomer/SWNT composites appears to be attributable to (1) a better match between the ductility of the fibers and the elasticity of the matrix and (2) the greater tensile strengths of SWNTs, relative to MWNTs.

For the experiments, several composites were formulated by mixing various proportions of SWNTs and other filling materials into uncured RTV-560, which is a silicone adhesive commonly used in aerospace applications. Specimens of a standard "dog-bone" size and shape for tensile testing were made by casting the uncured elastomer/filler mixtures into molds, curing the elastomer, then pressing the specimens from a "cookie-cutter" die.

The results of tensile tests of the specimens showed that small percentages of SWNT filler led to large increases in stiffness and tensile strength, and that these increases were greater than those afforded by other fillers. For example, the incorporation of SWNTs in a proportion of 1 percent increased the tensile strength by 44 percent and the modulus of elasticity (see figure) by 75 percent. However, the relative magnitudes of the increases decreased with increasing nanotube percentages because more nanotubes made the elastomer/nanotube composites more brittle. At an SWNT content of 10 percent, the tensile strength and modulus of elasticity were 125 percent and 562 percent, respectively, greater than the corresponding values for the unfilled elastomer.

This work was done by Bradley S. Files and Craig R. Forest of **Johnson Space Center**. *Further information is contained in a TSP (see page 1).* *MSC-23301*



The **Stiffness of a Silicone Elastomer** filled with several different kinds and proportions of reinforcing materials was measured in standard tensile tests.