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Plate impact experiments on the silicone elastomer DC745U cooled to -60 degrees C A. B. GOODBODY, D. M. DATTELBAUM, B. D. BARTRAM, R. L. GUSTAVSEN, Los Alamos National Laboratory — Filled elastomers are used in a variety of engineering applications such as structural supports and vibrational damping components. Silica and quartz fillers are commonly used with rubbery elastomers, such as cross-linked polydimethylsiloxane, to provide improved mechanical and creep properties in such applications. However, the shockwave properties and dynamic response of this class of materials are poorly characterized. For example, it is expected that filled elastomers would exhibit viscoelastic effects under high strain rate (shock) loading, and that glass and melt transitions may play a role in their dynamic compressibility. Using gas-gun-driven plate impact techniques, we have measured the Hugoniot of the filled silicone elastomer DC745U at ambient temperature, and cooled to -60 +/- 2 degrees C. At - 50 degrees C, DC745U crystallizes with 40% crystallinity, accompanied by a density change from 1.31 g/cm^3 at 23 degrees C to 1.45 g/cm^3 at -60 degrees C. Below the crystallization transition, a measurable increase in the bulk shock velocity was observed which is coincident with a decrease in compressibility due to crystallization of the polydimethylsiloxane repeat units. The linear $U_s - u_p$ Hugoniot changed from $U_s = 1.62 + 1.74\ u_p$ mm/s at 23 degrees C to $U_s = 2.03 + 2.03\ u_p$ mm/s at -60 degrees C. Thus, cooling to -60 degrees C results in considerable stiffening. This is the first time, to our knowledge, that a polymer crystallization transition has been shown to affect shockwave properties in this way. Viscoelasticity was also observed in the room temperature experiments.

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