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George Duval Award Talk: Unusual behavior of usual materials in shock waves

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The shock-wave techniques provide unique capabilities to study mechanical behavior of materials at extremely high strain rates. Under these conditions, response of solids in some cases is unexpected and exotic. Temperature effects on the flow stress at high strain rate may differ even in sign from that we observe at low and moderate strain rates. Strengthened metals and alloys may demonstrate even lower HEL value than normally less hard ones. At highest strain rates, so-called ideal (ultimate) shear and tensile strength is reached. In the presentation, recent experimental data on the elastic precursor decay and rise times of plastic shock waves in several metals and alloys in various structural states at normal and elevated temperatures are discussed and systematized. The data on precursor decay include measurements at micron and submicron distances where realized shear stresses are comparable with their ideal values. An analysis of the rise times of plastic shock waves shows by order of magnitude faster plastic strain rates at corresponding shear stresses than that at the HEL that is treated as an evidence of intense multiplication of dislocations. The spall strength not necessary correlates with dynamic yield stress.