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Crystal Structure Effects on Surface Fractures of Impacted Cubes
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Laboratory, Dahlgren, VA 22448-5100 — Cubes (9.53 mm on edge) of polycrystalline
and single-crystal forms of a nickel-based superalloy (62.5 percent Ni) were impacted
in vacuum at 747 m/sec by gas-gun-accelerated 3.18-mm-thick disks of 7075-T6
aluminum. Each cube was supported in a frangible holder on the gun muzzle.
Impacts occurred between a disk flat surface and a cube flat surface, followed by soft
recovery of these items. Visible fractures on the cubes were primarily associated with
the impact surfaces. The polycrystalline cube showed an irregular pattern of many
open cracks, forming columnar regions with axes normal to the impact plane; some
of these regions at the edges were broken away. The single crystal cube (impacted on
a face perpendicular to the [100] direction) showed only minor cracks at the center
of the cube face and near the centers of the face edges. The observed differences
suggest higher impact toughness for the single crystal material; the absence of grain
boundaries may increase the threshold for fracture initiation.

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