

GRAIN SIZE EFFECTS ON THE MECHANICAL PROPERTIES OF BULK STRUCTURAL MATERIALS

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Abstract

The advanced design of structural materials relies on the optimization of key combinations of multi mechanical properties such as yield strength, tensile strength, fracture toughness, fatigue strength, environmental resistance, brittle to ductile transition temperature and formability. Often conventional processing of materials designed to achieve specific microstructures has opposite effects on some of these mechanical properties such as strength and toughness. Grain size refinement has been the main microstructural design that has been observed to drive simultaneously to an improvement on the majority of these properties. The degree of this improvement has been often quantified by appropriate Hall-Petch type of equations. However there has been signification controversy on the operational mechanisms of strengthening and toughening, the meaning of grain size and the range of applicability of mechanical improvement by grain size refinement. This paper discusses some of these challenges drawing across various structural materials.

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