# Mechanical properties of metal/ceramic composites

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Distributing metallic particles in a ceramic matrix results in composites with enhanced mechanical properties, such as strength and fracture toughness, surpassing the properties of the conventional monolithic ceramics. The objective of reinforcing a brittle ceramic matrix with ductile second-phase inclusions by merging two different types of materials is to augment their durability and reliability. Ceramics are characterised by properties that are desired in structural applications, such as stiffness, strength, low density, chemical stability, high resistance to elevated temperatures and harsh environments. Metals are characterised by their ductile nature as they can develop plastic deformation accompanied by extensive energy absorption around a propagating crack during failure of the material.

Metal-particle reinforced ceramics usually consist of an aluminium oxide (alumina) matrix and a reinforcing metallic phase such as nickel, iron, titanium, molybdenum or copper. The metallic particles that are employed to reinforce the matrix induce the activation of various toughening and strengthening mechanisms, which improve the fracture behaviour of the composite in terms of strength and fracture toughness. This study attempts to elucidate the effect of various parameters of the components and their interactions on the optimum mechanical properties of the composite structure. The volume fraction and geometry of particles, the matrix grain size, the thermoelastic properties of the constituents are some of the key factors in designing and manufacturing ceramic matrix composites.

Even though toughness is in generally enhanced by the addition of metallic particles in the ceramic matrix, the elastic properties of the composite, such as Young's modulus, usually fall much below the predictions of most available models for composites. This apparent failure of the models is also examined in the present work. The applicability or not of existing models is examined, reasons of their failure are analysed and possible solutions are presented and discussed.

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