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Data Article

Properties of particle phases for metal-matrix-composite design

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ABSTRACT

Successful metallurgical design of metal-matrix-composites relies on the knowledge of the intrinsic property profiles of the metal matrix and especially the compounds employed for particles, whiskers or fibres. In this work we compiled the key properties melting point, bulk modulus, shear modulus, Young's modulus, density, hardness, Poisson's ratio and structure/space group from the widespread literature data for the most relevant compound types, i.e. borides, carbo-borides, carbides, oxides, nitrides and intermetallic phases.

Specifications Table

Subject area	*Physical metallurgy, Material Science, Engineering*
More specific subject area	*Metal-matrix-composites*
Type of data	*Table*
How data was acquired	*Literature survey*
Data format	*Raw, processed*
Experimental factors	–
Experimental features	–
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Value of the data

- The comprehensive data collection allows straightforward comparisons of individual properties, types and groups of compounds.
- Readily obtainable ratios of properties allow judging particles concerning their suitability for specific design goals (such as the material stiffness/density ratio).
- Specific effects of particles on the properties of the bulk composite can be estimated, for example regarding the co-deformation of particles and matrix influenced by their crystallographic coherency, or the amount of particles required for a specific gain in stiffness.

1. Data

Metal-matrix-composites allow overcoming the specific limitations of metallic and ceramic materials by blending their typically mutually exclusive property profiles. Knowledge based design of the composites requires, depending on the desired property profile and application, the choice of suitable metallic matrices and particles characterized by their intrinsic properties. In the following table the intrinsic properties (melting point, bulk modulus (B), shear modulus (G), Young's modulus (E), density, hardness, Poisson's ratio and structure/space group) of different types of phases (borides, carbo-borides, carbides, oxides, nitrides and intermetallics) are compiled from literature sources. The reference for each value or range of values is listed next to it on the right. Unless specified otherwise, values were assumed to have been determined experimentally as specifications are in most cases not given in the listed references. Densities determined by X-ray diffraction (XRD) are enclosed in curved brackets {}. Theoretically determined values are marked with a star *. Furthermore, the main selection criteria brittleness (expressed by the B/G ratio; B/G values below 1.75 are considered to represent 'more brittle' compounds [1]) and specific modulus (i.e. the E/density ratio) have been derived. If more than one value is given for E and density of a compound, i.e. several values from one reference or diverging values from different references, the E/density ratio is given as a range. In case of several values listed for B and G, the determined B/G ratio was chosen conservatively using the lowest B and highest G value, respectively (Table 1).