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Nanolaminated Ternary Carbide (MAX Phase) Materials for High Temperature Applications

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Abstract

There is a clear need for high-strength (≥ 300 MPa), thermally stable, conductive materials that are also thermal shock resistant. Some MAX phases – ternary nano-laminated carbides and nitrides – are reported to fulfil all these requirements and can be considered as potential structural materials for high-temperature applications. In this work, a set of quaternary (M,M')AX phase materials based on the Nb-Al-C system were synthesised by reactive hot pressing, starting from M-hydride powders. The possibility to substitute Nb with at least 10 at% of other M elements (M' = Ti, Zr, Hf and Ta) in the crystal lattice was investigated. The crystal structure of the produced solid solutions was studied by X-ray diffraction and the lattice parameters were calculated by Rietveld refinement. The material behaviour in an inert atmosphere was tested by measuring the elastic properties – Young's Modulus and internal friction – as a function of temperature up to 1500°C, and the effect of the substitution on the room temperature flexural strength was assessed.

Keywords

MAX phases, Solid solutions, X-ray Diffraction, Elastic properties