

## Densification/Consolidation of MoSi<sub>2</sub>-TiB<sub>2</sub> composites produced by in-situ reactions.

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Molybdenum disilicide is one of the three intermetallic phases in the Mo-Si binary system [1] with potential for high temperature applications [2]. Its most attractive properties are its high melting point (2020°C), reasonable density (6.24 g/cm<sup>3</sup>) [3], and excellent high temperature oxidation and corrosion resistance. However, low ambient fracture toughness and loss of strength at elevated temperatures have been the most significant limitations to the use of MoSi<sub>2</sub> in structural applications. The more promising solutions for improving the mechanical properties of brittle intermetallics, such as MoSi<sub>2</sub>, are based on the incorporation and control of secondary phases. Thus, borides have been studied as a reinforcing phase and among them, TiB<sub>2</sub> has shown to provide the best compromise in density and improvement in mechanical properties at high temperatures [4,5,6]. Also, it has been shown that in-situ processing of these composites through solid-state reactions is the route that offers the best possibility of producing thermodynamically stable microstructures [2].

Reactant particle size and nature of the reactants have been found to be determinant factors in the densification/consolidation of the composites produced by in-situ reactions. In addition, particle size is one of the most important controlling parameters for the reaction rates in these reaction-sintering processes. As expected, faster formation rates are observed when the particle size of the reactants is smaller; however, the introduction of impurities such as oxides formed at the surface of the particles is more significant.

In this study, two different scales of reactant powders sizes: 0.04 – ≈40μm (“small”), and 40-≈200μm (“large”), and elemental vs. displacement reactions were evaluated to assess the impact on the densification/consolidation stages of the processing of MoSi<sub>2</sub>-TiB<sub>2</sub> composites. A larger oxygen content in the system introduced as surface oxides in the small reactant powders lead to the formation of “Silica Pockets”, as the most distinctive characteristic of the resulting microstructures.

### References

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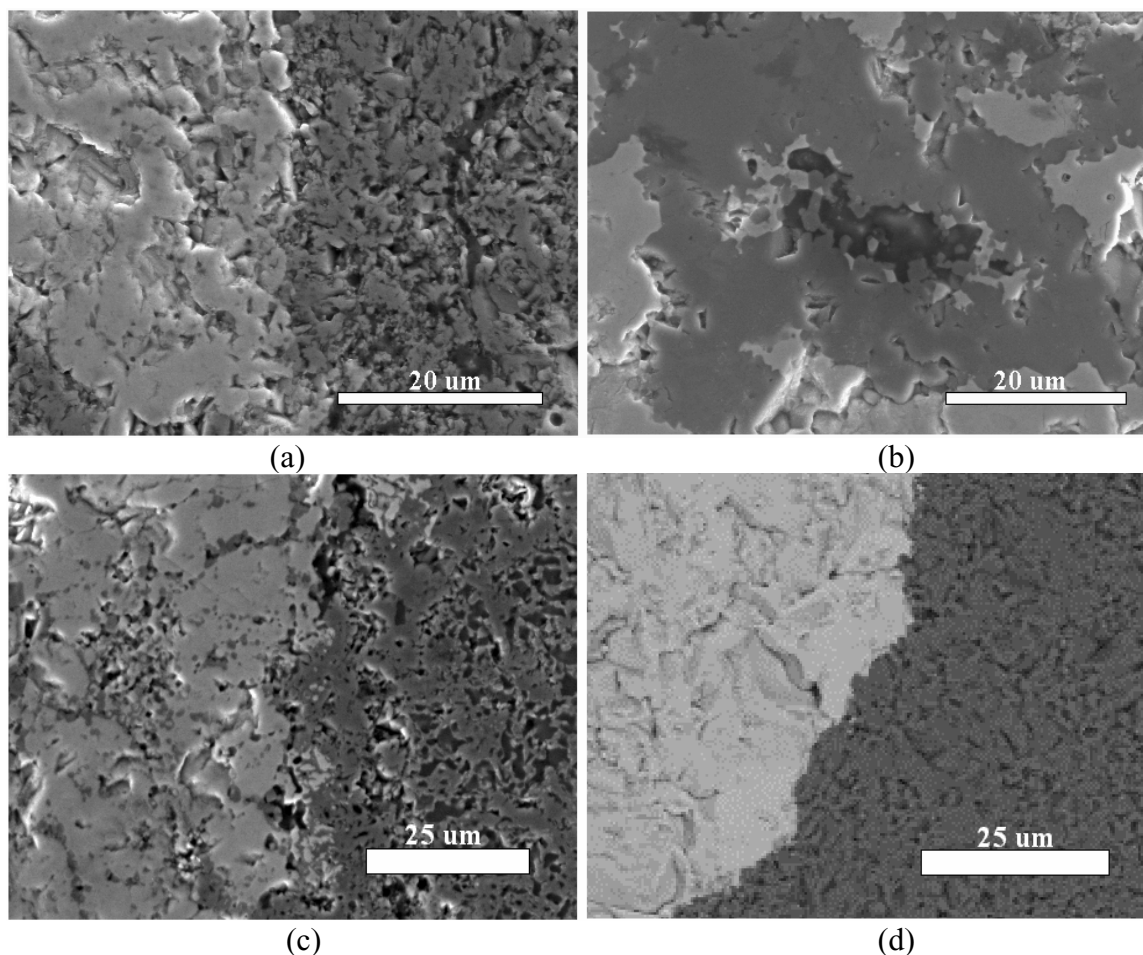


Fig. 1. Scanning electron micrographs (SEM) corresponding to samples (a) Displacement reaction-“small” reactant powders, (b) Elemental reaction-“small” reactant powders, (c) Displacement reaction-“large” reactant powders, and (d) Elemental reaction-“large” reactant powders, to compare the degree of densification achieved.

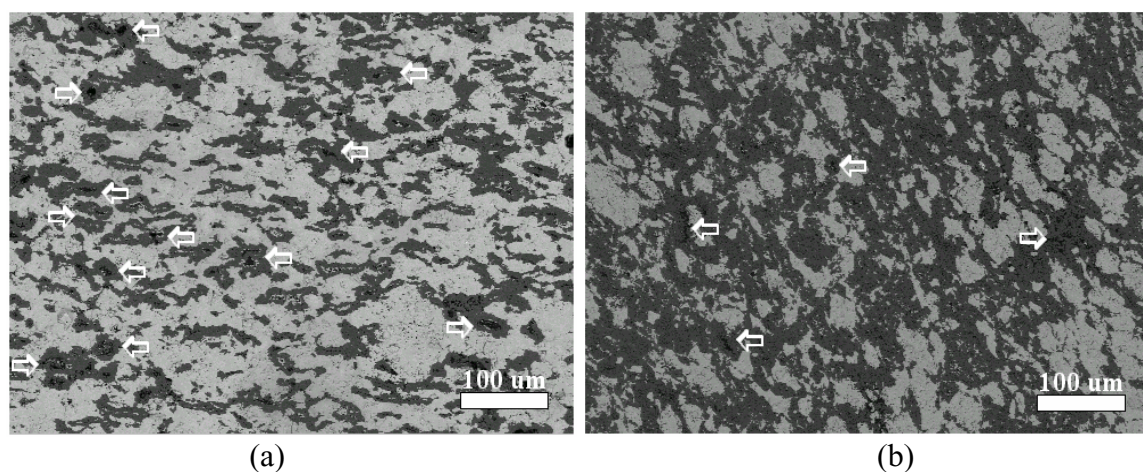


Fig. 2. Backscatter electron images of the general microstructure of the samples (a) Elemental reaction-“small” reactant powders, and (b) Displacement reaction-“small” reactant powders indicating with arrows the “Silica Pockets”.