

Near-zero Thermal Expansion in Freeze-Cast Composite Materials

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Supplementary Materials for *Ceramics* (2019)

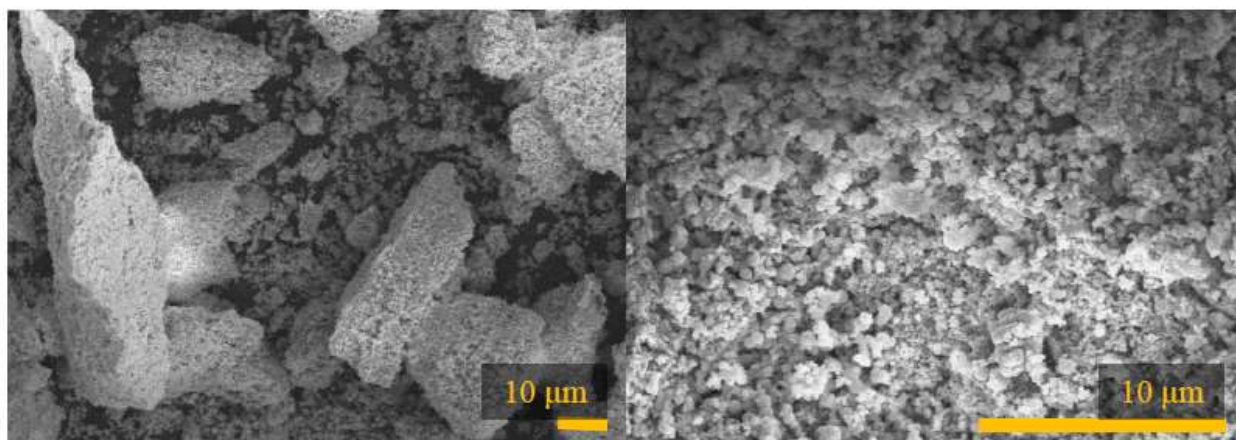


Figure S1. Scanning electron micrographs of aluminum tungstate particles prior to ball milling. The image on the left shows the range of agglomerate sizes. The image on the right shows a close up image of an agglomerate, revealing them to be aggregates of smaller particles.

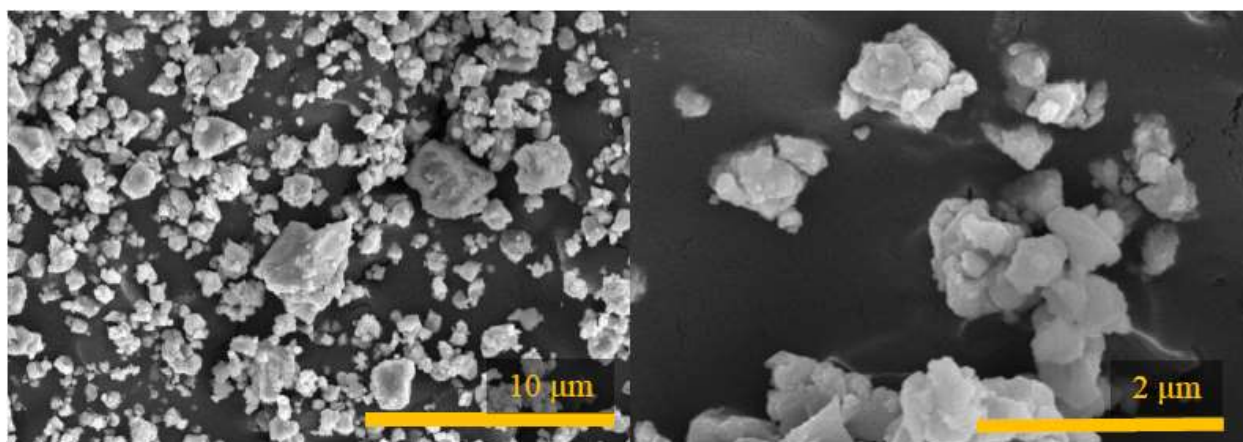


Figure S2. Scanning electron micrographs of aluminum tungstate after ball milling. The image on the left shows the range of particle sizes. The image on the right shows that the particles are still agglomerates of smaller particles.

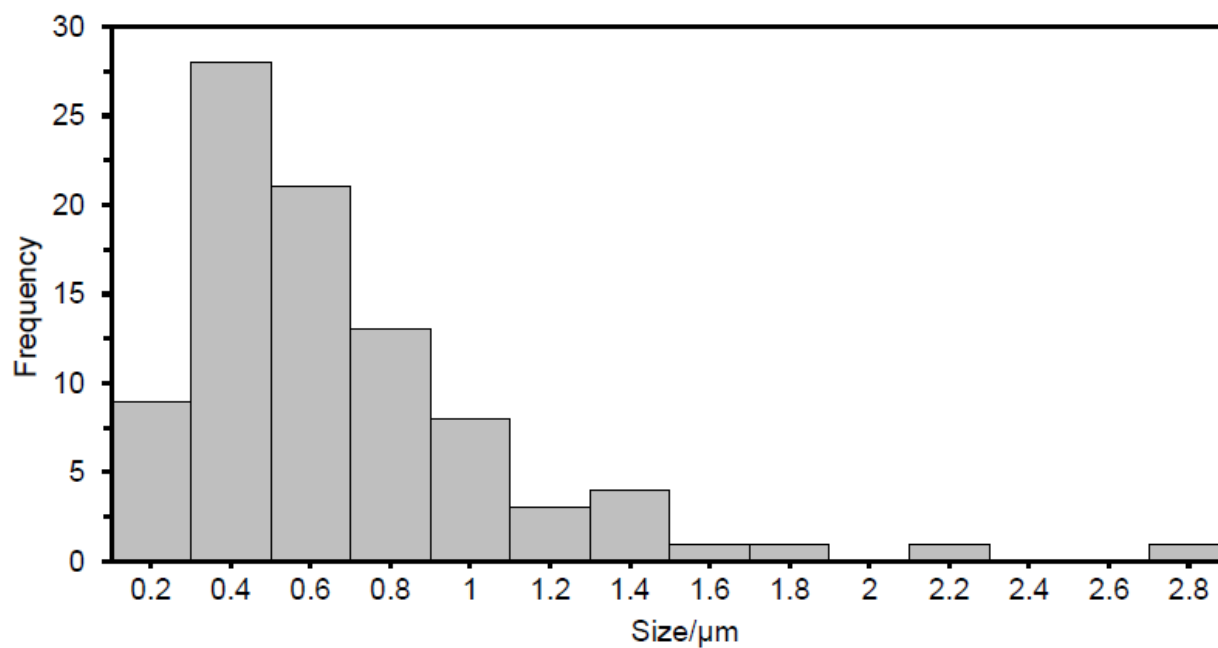


Figure S3. Histogram of aluminum tungstate particle sizes after ball milling.

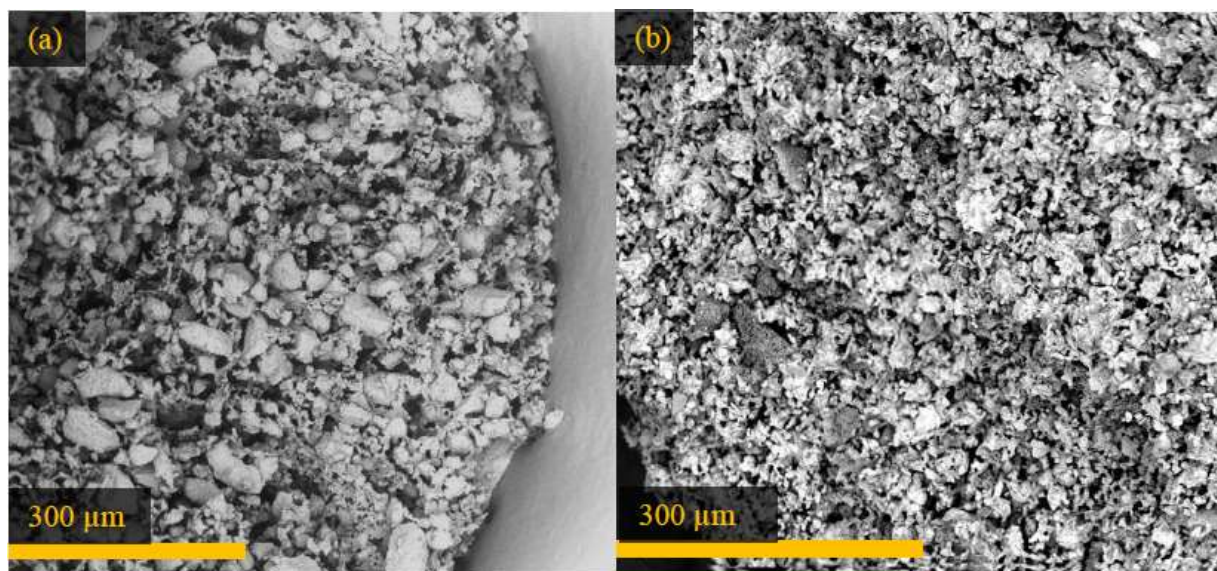


Figure S4. SEM images of $\text{Al}_2(\text{WO}_4)_3$ scaffolds, illustrating the influence of improved dispersion techniques. Both images show cross sections of scaffolds perpendicular to the temperature gradient, cut 2 mm from the base: (a) scaffold produced from a slurry dispersed using a magnetic stirbar, and (b) scaffold produced from a slurry dispersed using a planetary mill.

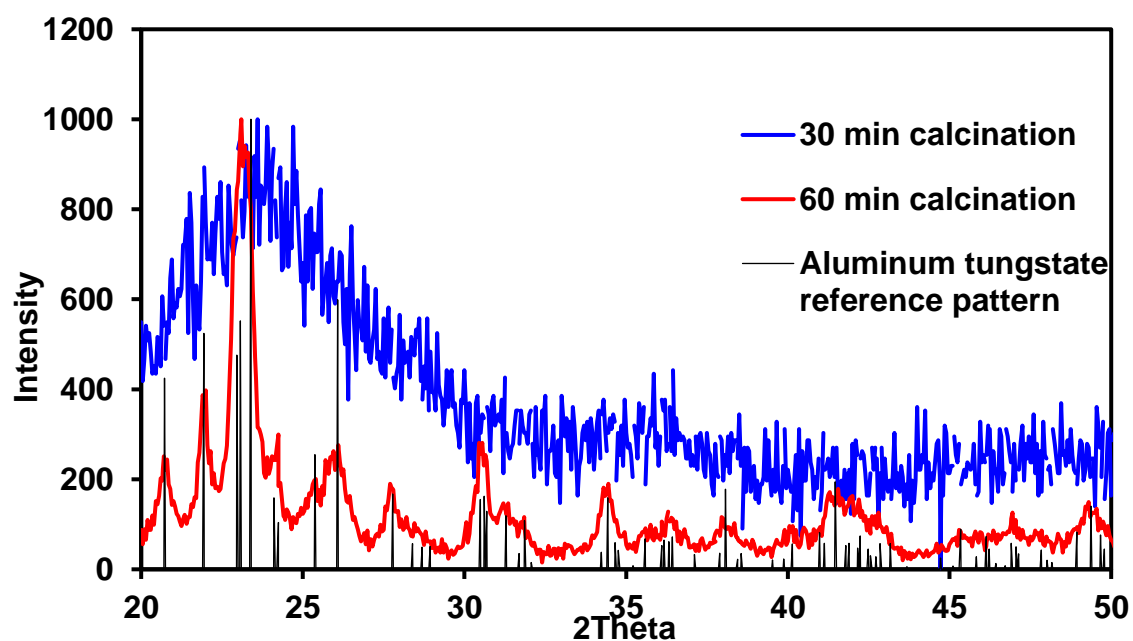


Figure S5. XRD pattern of aluminum tungstate particles after calcination at 750 °C for various times.

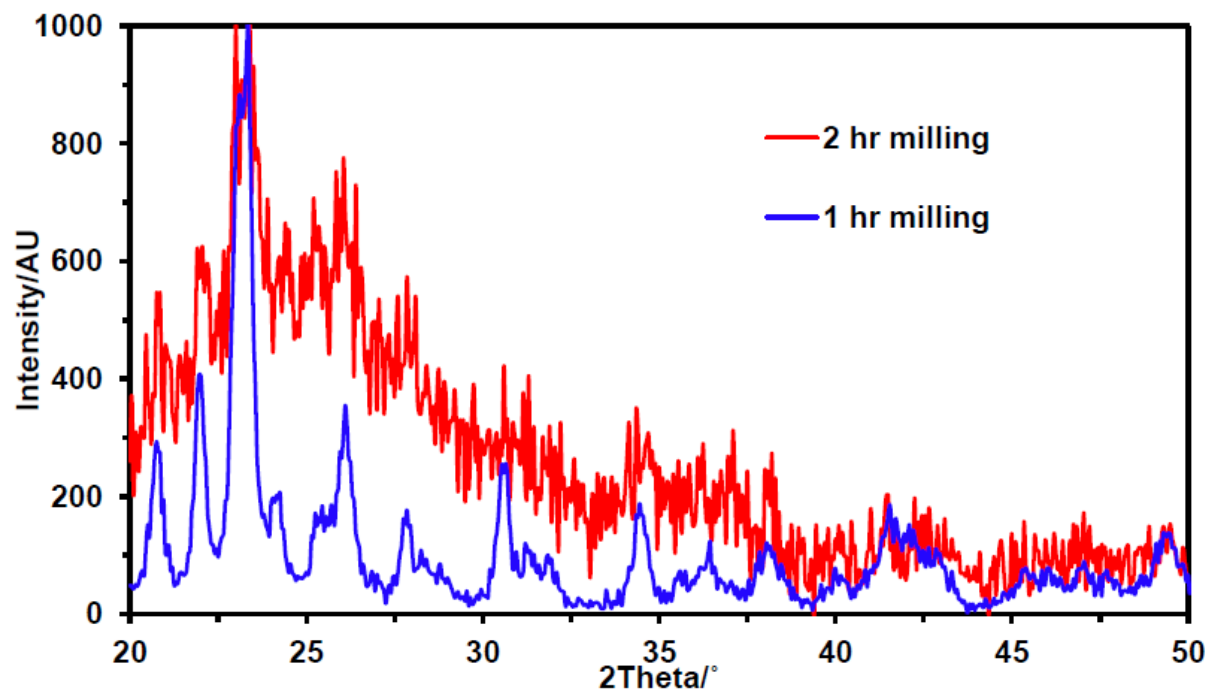


Figure S6. XRD pattern of aluminum tungstate after ball milling for various times.

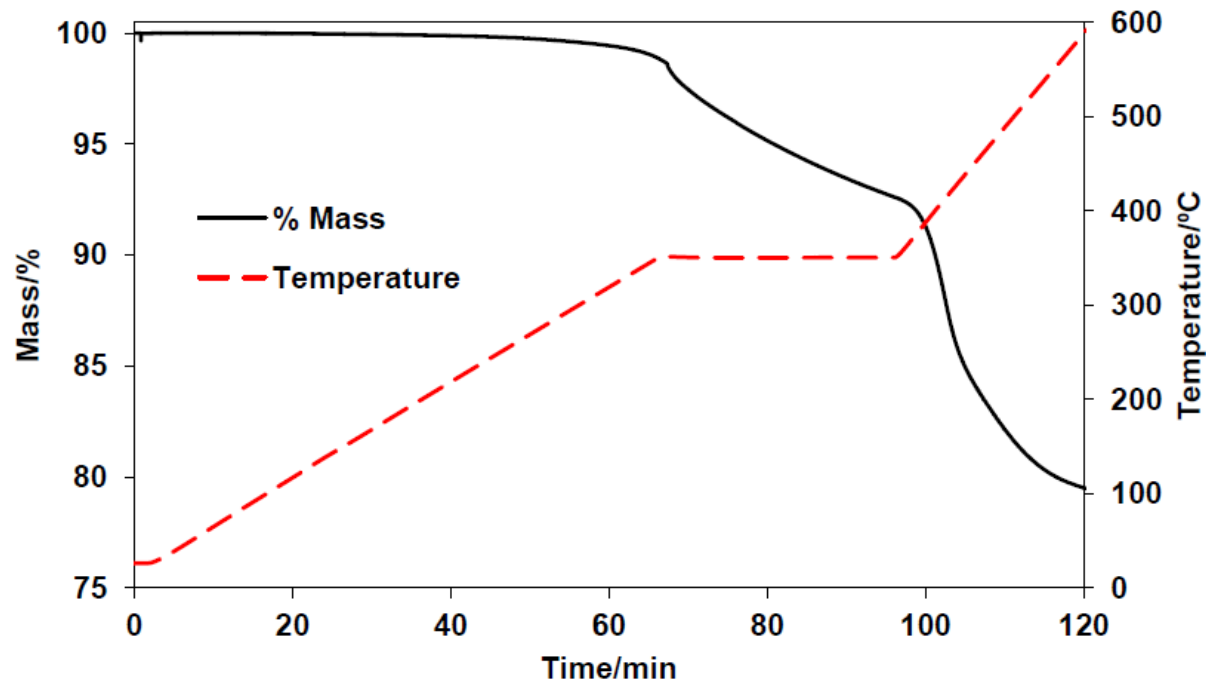


Figure S7. TGA thermogram of an aluminum tungstate-PMMA composite. The changes in mass and temperature are shown as functions of time.