Vol. 15, Number 1, 2006

Titanium Diboride – Titanium Aluminides Composites Prepared by SHS under Normal and Microgravity Conditions: A Microstructural Study

F. Lemoisson[1], J. De Wilde[1], R. Orrù[2], I.A. Beloki[4], R. Licheri[2], A. Sytchev[5], A. Rogachev[5], G. Cao[2,3], D.J. Jarvis[6], and L. Froyen[1]

[1] *Departement MTM, K.U. Leuven, Belgium*
[2] *Dipartimento di ingegneria chimica e materiali, Centro studi sulle reazioni autopropaganti, Università degli studi di Cagliari, Italy*
[3] *Promea Scarl, c/o Dipartimento di fisica, Cittadella universitaria di Monserrat, Italy*
[4] *INASMET, Spain*
[5] *Institute of Structural Macrokinetics and Materials Science, Russian Academy of Science, Russia*
[6] *European Space Agency, The Netherlands*

ABSTRACT

Within the frame of the Belgian Taxi-flight mission ODISSEA, microgravity self-propagating high-temperature synthesis (SHS) experiments on the production of intermetallic matrix composites (IMCs) based on the Al-Ti-B system were performed in the International Space Station (ISS) [1]. Depending on the composition, different intermetallic compounds can be formed: titanium aluminides, which act as a matrix phase, and titanium diboride, which is present as a reinforcing particulate phase. The present experiments consist of cylindrical samples with a conical end, the last one being integrated in a copper block with a conical cavity in order to perform combustion front quenching. The cylindrical part can be used to study the combustion process in a stationary regime.

A comparative analysis is performed between samples processed in reduced gravity and normal gravity. Microstructure formation is a focal point. The elimination of gravity-dependent phenomena such as convection and spreading of molten components, buoyancy, and sedimentation of inert solid particles and droplet coalescence streamlines the research focus. Under certain conditions, gravity-dependent secondary processes may also occur in the heat-affected zone after combustion. Other phenomena masked by gravity include diffusion and Marangoni convection.

In the present paper, the effect on the microstructure of both gravity and initial composition are assessed in terms of morphology and composition of the matrix phase as well as in terms of the size and the morphology of the particulate phase.