Abstract of Presentation

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Presentation Title(Should be no more than 20 words):

Functional Compound Combustion Synthesis under Centrifugal Force and Microgravity

Abstract :

Combustion Synthesis is a rapid, versatile, near net shaping technology that has been advantageously applied to high-temperature material synthesis and processing combined with inertial-force effects such as centrifugal force and microgravity.

As an application of the former, metal-ceramic composite pipes longer than 5m have been produced by a thermite reaction induced in a rotating tube("Centrifugal-Thermite Process") as a part of geothermal energy materials R&D. The significant feature for such performance is mainly in its reaction propagation under centrifugal effect as well as the centrifugal force and reaction heat; the reaction first proceeds rapidly along the inner surface of the reactant and then in the radial direction, resulting in a homogeneous quality in the direction of pipe length.

In the latter, III-V and II-VI compounds, such as GaP, InP, (Ga, In)P and $CuInS_2$ have been successfully synthesized under a microgravity environment(MGE) formed with a dropping tower(10^{-4}G for 10s) or parabolic flight(10^{-2}G for 20s) as a part of fine composite compound solar cells R&D. The particles of InP obtained in the MGE were finer and more uniform than those obtained in the terrestrial condition. The above combustion synthesis technology has been extended to the preparation of the compounds such as Mn-GaP, Mn-InP and Mn-(Ga, In)P, which are in category of III-V based dilute magnetic semiconductors. In order to assess the potential of combustion synthesis technology applied under centrifugal force and microgravity and show their effects on high-temperature composites formation more clearly, systematic experiments should be carried out under various mass-forced conditions.

In last November, Space-DRUMS(Dynamically Responding Ultrasonic Matrix System) facility was launched into space and installed on the International Space Station, which is a dedicated ISS facility to demonstrate the effect of low gravity on combustion synthesis developed by the principal investigator, Dr. J. Guigne, as a NASA commercial scenario. As an operational facility, Space-DRUMS® can produce lightweight, high temperature insulator and structural materials to lower the costs and increase safety for low earth orbit and reentry operations. Our investigations on micro-gravitational combustion synthesis can be also carried out on the ISS.