Scanning Electron Microscopy of Fracture Reveals Significant Grain Boundary Weakness in Lithium Fluoride Doped, Vacuum Hot Pressed and HIPped Transparent Magnesia Spinel.

Polycrystalline ceramics with cubic Spinel structure transmit well in the visible and mid IR wavelengths of the electromagnetic spectrum. ALON® and Magnesia Spinel are especially attractive and are leading lightweight transparent Armor candidates for future combat systems. These have enormous performance advantage over glass and justify their rapid development.

Burlington, MA. (PRWEB) January 31, 2012 -- Surmet achieves full density and transparency using the conventional Sinter/HIP (Hot Isostatic Press) process that includes green body formation, high temperature sintering, followed by HIPping. While Surmet alone makes ALON®, Surmet is not the only company making Magnesia Spinel using the sinter/HIP process.

For decades, magnesia Spinel has been processed to full transparency using lithium fluoride doped starting powder followed by vacuum hot pressing and HIP, known as the LiF/HP/HIP process. During hot pressing, lithium fluoride (LiF) acts as flux, melts and wets the powder surfaces causing rapid densification via liquid phase sintering. Several companies are gearing up to produce Spinel for Armor using LiF/HP/HIP method.

However, a recent scanning electron microscopy (SEM) study has uncovered significant grain boundary features that raise questions about the suitability of this product in applications requiring high levels of mechanical strength, toughness and impact resistance. The study revealed that lithium fluoride assisted liquid phase sintering results in rapid grain growth and mechanically weak grain boundaries due probably to massive grain boundary embrittlement by lithium fluoride.

Using the conventional Sinter/HIP process, Surmet makes Spinel that is fine-grainedand many times stronger. The fracture surface of Sinter/HIPped Spinel, exhibits no evidence of detrimental features, even when viewed at magnifications ten times higher. The fracture occurs in a trans-granular mode, typical of high strength materials.

In lithium fluoride doped, hot pressed and HIPped Spinel, the grains simply seem to separate when subjected to stress. To avoid this, it is imperative that 100% of the lithium fluoride be removed after it has done its fluxing function. That is a difficult challenge. Factors that make LiF effective also make it difficult if not impossible to remove it completely.

Missile domes that have thin cross section geometry are especially vulnerable to breakage when the grains are large and are held together weakly. This issue needs to be addressed head on before spinel components produced using LiF doping are broadly deployed. It is very important to find out what effects this grain boundary weakness has on ballistic performance.

Founded in 1982, Surmet Corporation is an Advanced Materials Development & Manufacturing Company. Head Quartered in Massachusetts, Surmet has R&D and manufacturing facilities in, Buffalo, NY and Murrieta, CA. Surmet is grateful to the US Department of Defense for multiple funding supports.

To find out what Surmet can do for you, visit our website http://www.surmet.com

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