ID de la contribución: **330** Tipo: **Oral Presentation**

New hardness model for fine fibrous eutectic ceramics prepared by laser-heated floating zone (LFZ)

miércoles, 15 de septiembre de 2021 17:30 (20 minutos)

The fabrication of two eutectic ceramic systems (MgAl2O4-MgO and Y2O3-MgO) with fine fibrous microstructure by laser-heated floating zone (LFZ) method for optimization of their mechanical properties was studied. The low growth rate causes coarsening the fibre interspacing which is detrimental for the hardness. Gradual enhancement of hardness happened for eutectic ceramics fabricated at higher growth rates. Favourably, it showed elevated hardness at 750 mm/h growth rate (15.5 GPa from Vickers indentation for MgAl2O4-MgO and 11.5 GPa from Vickers indentation for Y2O3-MgO). It is found that hardness scales with the interfiber spacing (Landa) according to a law of the type ln Landa/Landa, different from the assumed Hall-Petch-like dependence. This proposed law can be explained in terms of dislocation hardening induced by the MgO fibers.

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Clasificación de la sesión: C11_Laser based processing an manufacturing

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