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

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Abstract:

The fabrication of two eutectic ceramic systems ($MgAl_2O_4$-MgO and Y_2O_3-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 $MgAl_2O_4$-MgO and 11.5 GPa from Vickers indentation for Y_2O_3-MgO). It is found that hardness scales with the interfiber spacing I according to a law of the type lnl/l, 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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