COLUMNAR THERMAL BARRIER COATINGS MANUFACTURED BY NOVEL LASER CLADDING PROCESS

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Key Words: Thermal Barrier Coatings, Laser Cladding, Columnar Structure, Burner Rig Testing

In recent years, additive manufacturing by laser-assisted processes (direct laser deposition, selective laser melting) has enabled the realization of novel component designs and targeted repair processes, especially in the field of metallic materials. This is mainly due to the great freedom that exists in terms of dimensions and geometric configuration in additive manufacturing. In the case of ceramic materials, a comparable breakthrough has not yet been achieved, since the necessary high processing temperatures and the lack of ductility of ceramics often causes the occurrence of high local stresses and the formation of cracks in structures of relatively small size. Thus significantly hindering the build-up of defect-free components.

Especially the application as thermal barrier coating offers special constraints on the microstructure owing to the requirements for thermal shock resistance of the coatings, which are well suited for laser-based additive manufacturing: For example, the occurrence of porous areas or segmentation cracks can not only be tolerated, but contributes decisively to the function and lifetime of the coatings. In this study, constraints for the deposition of porous YSZ in the conventional laser cladding process are investigated. Further, an adapted process for the deposition of columnar structures is presented, which can be used for the manufacture and small scale repair of thermal barrier coatings. The stability and durability of these TBCs manufactured by novel laser-cladding process were investigated in burner-rig test. Lifetime and failure mode qualify the coatings being at least at the same level as conventional TBC systems.