Effects of encapsulating material and healing agent ratio on crack propagation behavior for thermal barrier coatings

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Thermal barrier coatings (TBCs) are important parts to protect metallic substrate in gas turbine engines because turbine inlet temperature is continuously increased to improve fuel efficiency. Recently self-healing TBCs have been proposed to prevent delamination and spalling of TBCs during gas turbine operation. In this study, $MoSi_2$ as the healing agent was coated by three kinds of materials such as tetraethyl orthosilicate (TEOS), sodium methoxide (NaOMe), and their mixture (TEOS + NaOMe) for stabilizing $MoSi_2$ at high temperatures. YSZ and capsulated $MoSi_2$ were mixed with 90:10, 80:20, and 70:30 wt% ratios, respectively. Samples were fabricated by uniaxial compaction at 100 MPa and then sintered at 1300 ^oC and 1500 ^oC, respectively. Crack propagation behavior was investigated as functions of $MoSi_2$ stabilizing agent, stabilized $MoSi_2$ content, and sintering temperature. Furnace cyclic test (FCT) was performed at 1100 ^oC for a dwell time of 40 min, followed by natural air cooling for 20 min at room temperature, after generating artificial cracks in TBC samples by using Vickers indentation. The TBC sample with the $MoSi_2$ of 20 wt% capsulated with the mixture of TEOS and NaOMe and sintered at 1500 ^oC showed the best healing effect in FCT test. This study allows us to design reliable TBC systems in operating conditions.