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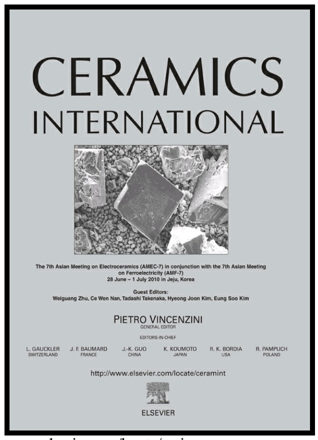

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Damage characterization model of ceramic coating systems based on energy analysis and bending Tests

H. Y. Liu[a,b], Y. G. Wei[a,b,*], L. H. Liang[a,c,*], X. H. Liu[a], Y. B. Wang[a], H. S. Ma[a]

[a] *LNM, Institute of Mechanics, Chinese Academy of Sciences, Beijing 100190, China*

[b] *College of Engineering, Peking University, Beijing 100871, China*

[c] *University of Chinese Academy of Sciences, Beijing 101408, China*

ABSTRACT

A quantitative damage model of ceramic coating systems was developed based on their load-displacement curves obtained from three-point bending tests. According to the energy mechanism of damage, the normalized damage rate of such systems can be simply expressed using the load and the tangent slope of their load-displacement curves. The experimental results demonstrated the thickness dependence of fracture and damage. In thin coating systems, tensile failure was found to be predominant and multiple transverse cracks appeared in the coatings. In contrast, thick coating systems showed a predominance of interface shear failure and the occurrence of interface delamination. These observations are consistent with previous experimental results. The damage of the systems displayed catastrophic characteristics when the load tended to reach the failure point, i.e., the damage increased rapidly, and the damage rate displayed a power-law singularity at the failure point. These results are consistent with the damage characteristics predicted using the mathematic model. The damage evolution in the case of interface delamination in the thick coating systems was faster than that for transverse cracking in the thin coatings because of the difference in the degree of damage localization. The present model provides an effective method to elucidate the damage behavior of brittle ceramic coating systems, and hence, it is expected to greatly aid the coating design.

Keywords: ceramic coatings, damage characterization, fracture, thickness effect

[*] Corresponding authors, *E-mail addresses*: weiyg@pku.edu.cn (Y. G. Wei), lianglh@lnm.imech.ac.cn (L. H. Liang).