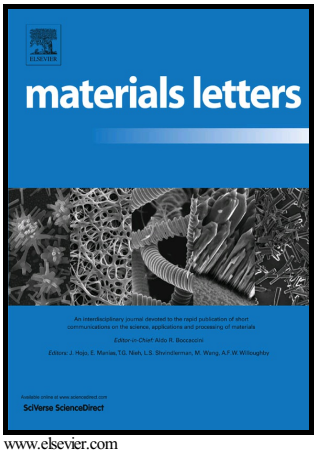

Influence of thermal shock damage on the flexure strength of **alumina ceramic at different temperatures**

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Influence of thermal shock damage on the flexure strength of alumina ceramic at different temperatures

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Abstract

Alumina ceramic specimens that suffered a specific water quench thermal shock were used for three-point bending test at different temperatures to investigate the effect of thermal shock damage on flexure strength for the first time. Results indicate that the sensitivity of the alumina flexure strength to thermal shock damage decreased with increasing temperature. When evaluating the thermal shock resistance of alumina by using critical thermal shock temperature difference, which determined by thermal shock residual strength at room temperature, will result in one-sided conclusion for the thermal shock resistance of ceramics. The mechanism of sensitivity of alumina ceramic strength to the thermal shock damage at elevated temperature was analyzed by the microstructure of the facture surface with SEM images. Therefore, this study can provide references for engineering application of alumina materials and improve the understanding of thermal shock resistance for ceramic materials.

Keywords: Thermal shock resistance; Strength; Ceramics; Crack healing; Microstructure; Sensitivity

1. Introduction

Ceramic materials are used in a wide range of industries as high-temperature structural ceramic because of their excellent thermal physical properties, such as low dielectric constant, high melting point, high temperature mechanical stability and chemical inertness [1–4]. However, ceramics are brittle materials with low fracture toughness and poor thermal shock resistance. Damage evolution resulting from severe thermal shock will cause catastrophic failure when ceramics are used as structural component in complex operating environments. Numerous studies on the evaluation of thermal shock resistance of ceramic materials have been reported in recent years [5–10]. In the past decades, the water quench test has been widespread used method for its simplicity. But a number of problems of this method have been found in practical use. Some researchers [11,12] have tried to take measures to overcome the problems. However, the present evaluation method of thermal shock resistance for ceramics still cannot meet the demand of actual engineering applications. Because the determination of thermal shock resistance performance are always conducted at room temperature while the operating thermal environment of ceramic materials used in space vehicles thermal protection is suffered from a wide range of temperature variation. And the thermo-physical properties of ceramic materials are sensitive to temperature as well, especially at high temperature. The mechanical properties of ceramic materials after thermal shock and the effects of thermal shock damage on the mechanical performance of ceramics during operation are still unknown. Thus,