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Phase Field 모사를 이용한 결정립 성장연구

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결정립 성장은 결정립 계면에너지를 감소시키기 위하여 일어나는 대표적인 재료현상의 하나로 재료의 기계적, 물리적, 화학적, 전기적성질 등과 밀접한 관련이 있어 기술적인 측면에서 매우 중요하다. 본 연구에서는 S.G.Kim 에 의하여 개발된 Phase Field 모델을 이용하여순수한 재료의 결정립 성장에 대한 컴퓨터 모사를 적용하여 그동안 문제가 되어온 결정립 성장지수와 결정립 크기분포의 실험적 결과와 이론적 결과의차이를 해석하였다. 컴퓨터 모사는 PC를 이용하여실행하였으며 2차원의 경우에는 2000x2000 그리드 시스템을 3차원의 경우에는 300x300x300의 그리드 시스템을 사용하였으며초기 결정립의 수는 약 70, 000개를 사용하였다.

Keywords: Grain Growth, PhaseField, Grain Boundary Energy

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Thermal post-buckling and flutter boundaries of functionally graded panels subjected to aerodynamic loads

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At high speeds ofspacecrafts in atmosphere, skin panels may experience severe structural problemssuch as thermal post-buckling, flutter etc. Functionally Graded Materials(FGMs) have been developed with continuous change from metal to ceramic. FGMspossess excellent high thermal resistance and fracture toughness as comparedwith metal, ceramic and composite material. In this study, thermalpost-buckling and flutter boundaries of functionally graded (FG) panels inhypersonic airflows are investigated. The volume fraction and the materialproperties of FGMs are gradually changed from metal to ceramic in the thicknessdirection agreeably to a simple power law distribution and a linear rule ofmixture respectively. The material properties of the panels are dependent onthe temperature in high temperature environments. The governing equations are derivedby using the principle of virtual work and solved by using the finite elementmethod. The panels based on the first-order shear deformation theory (FSDT) aremodeled by the von Karman strain-displacement relation and the third-orderpiston theory is employed to consider the aerodynamic nonlinearity. TheNewton-Raphson iteration method is used to solve the nonlinear equation ofmotions. Flutter boundaries are obtained by linear flutter analysis. Theeffects of volume fraction, aerodynamic pressure, boundary conditions andtemperature change on thermal post-buckling and flutter boundaries are studied.

Keywords: post-buckling, flutterboundaries, functionally graded materials