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Micromechanics-Based Elastic Model for Functionally Graded Materials with Particle Interactions

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The present paper aims to develop a micromechanics-based effective elastic model of functionally graded materials (FGMs). The effective properties of FGMs are uniform in the same graded layer while changing along the grading direction. Microstructurally, infinite particles are randomly dispersed in the matrix with gradual transitions. Spherical particles are perfectly bonded with the matrix. A micromechanical framework is proposed to investigate effective mechanical properties along the grading direction. Within the context of the representative volume element, the effect of pair-wise interactions between particles is taken into account for the local stress and strain fields by using the modified Green's function method. Homogenization of the local field renders relations between the averaged strain, strain gradient and external loading. The effective elastic modulus tensor of the functionally graded composites is further constructed by numerical integration. The model prediction is compared with available experimental data.

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