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섬유 강화 금속 복합재료의 변형해석
(Deformation of Metal-Matrix Composites with Continuous Fibers)

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The present work describes the micro-mechanics of the elastic and plastic deformation in a uni-directionally reinforced metal where the effect of the fiber packing arrangement are examined using the finite element models. The materials selected as a model system for the numerical investigation of fiber distribution is a oxygen-free (OF) copper reinforced with SiC unidirectional fibers. The volume fraction of the fibers used for the majority of the analyses reported in this work was 20 %.

The cylindrical SiC fibers had a circular cross-section and their average diameter was 0.14 mm. The room temperature mechanical properties of the fiber are: Young's modulus, E^f = 430 GPa, Poisson ratio, υ^f = 0.17, and thermal expansion coefficient, α^f = 7×10^{-6} /K. The mechanical properties of the OF copper matrix are: Young s modulus, E^m = 130 GPa, Poisson ratio, υ^m = 0.343, yield stress, σ_y = 44 MPa, tangential modulus, σ_H = 1550 MPa and thermal expansion coefficient, α^f = 16.7×10^{-6} /K. Both fiber and matrix were assumed to be isotropic for the purposes of modeling the composite behavior. The numerical analysis of the stress-strain behavior of the composite was performed using finite element code ANSYS [6]. The description of matrix material involved rate-independent plasticity with isotropic hardening. Both small strain and finite strain formulations of the field equations were investigated with the initial unstressed state taken as reference. Because the ductility of the composite material is low (typically less than 1 %), the predicted difference in the stress-strain response for the small strain and finite strain formulations was less than 1 %.

1. T. Christman, A. Needleman, S.R. Nutt and S. Suresh, *Acta metal.* 37, 3029 (1989).
2. V. Tvergaard, *Acta metall. mater.* 38, 185 (1990).
3. T. Dragone and W.D. Nix, *Acta metall. mater.* 38, 1941 (1990).
4. J.R. Brockenbrough and S. Suresh, *Scripta metall. mater.* 24, 325 (1990).
5. J.R. Brockenbrough, S. Suresh and H.A. Wienecke, *Acta metall. mater.* 39, 735 (1991).