Mechanical Computations on Metal Matrix Composite Material

N. T. Long[1], V. C. Hoa[2], T. T. Thien[3], T. Q. Phong[4], and N. L. Dung[5]

Abstract: The purpose of this paper is to study the model of microscopic void growth in fissures of metal to apply to metal composite material. At first, the growth of initially spherical void in an infinite block of a plastic material is replaced by a hard material by N. L. Dung to form metal composite materials, so that the matrix and particle are plastic and there are no micro cracks between particle and the matrix during the deformation process. Then, the paper focuses on calculating the growth of the particle of metal composite. Calculation process is done by finite element method and analytical model. Particles are spherical or ellipsoid and are evenly distributed in the matrix and the surface between particles and the matrix is maintained during the plastic deformation of the matrix and elastic deformation of particles. It is noted that the analytical model has been improved and corrected by N. L. Dung from Mc. Clintock model for the growth of microscopic void in the fissures of metal. On the other hand, to describe the work hardening in the plastic deformation stage of metal and particle grow, N. L. Dung has proposed to add a function on the hard plastic material. Basically, it is the same as the function of plastic material of Lemaitre, Gurson et al. Results show the compatibility of the two models on displacement, strain and stress of the metal composite material model. Moreover, it is assumed that spherical or ellipsoid particles are evenly distributed and cyclical in the matrix, it is able to determine the nonlinear stress-strain curve and elastic properties of the metal composite material. Besides, the yield stress of metal composite materials is calculated in the view that when the metal matrix becomes plastic, stress from the matrix will be transmitted to the particles by using shear stress at the contact surface between the matrix and the particles, through the law of mixed materials. Calculation results of elastic modulus and ultimate stress are compared with experimental results of N. P. Hung. Materials here are F3S20SiCp calculated according to the standards of Singapore. Finally, computation model and frequency simulation model for the two difference typical wings of mini unmanned aerial vehicles are carried out by finite element method to optimize wing mass, in limiting the choice of traditional materials compared to metal composite material.

[1,2,3,4,5] Centre of Computational Mechanics, Department of Engineering Mechanics,
Faculty of Applied Sciences, Ho Chi Minh City University of Technology VNU-HCM,
Ho Chi Minh City, Vietnam
ntlong@hcmut.edu.vn, vuconghoa@hcmut.edu.vn, tttruong@hcmut.edu.vn, dungnl@yahoo.de