Thermal Stress Simulation of Ultrafine Plate-Fin Structures

Using a Homogenization Theory

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In this work, the thermal stress in ultrafine plate-fin structures made of a Ni-based alloy subjected to a macroscopic temperature increment is simulated macroscopically and microscopically, using a homogenization theory for thermoelastoviscoplasticity. For this purpose, the homogenization theory for thermoelastoviscoplasticity is constructed by introducing the effects of thermal expansion into the homogenization theory for time-dependent materials. The present theory is then applied to the thermal stress simulation of ultrafine plate-fin structures, in which three cases of macroscopic temperature rates are considered. The results show that the higher the macroscopic temperature rate is, the higher the thermal stress is. Moreover, it is shown that the stress concentration occurs at joint regions between plates and brazing parts, and at some parts of fins, indicating the importance of thermal stress analysis of ultrafine plate-fin structures.

Keywords: Homogenization, Ultrafine plate-fin structure, Thermal stress, Thermal expansion