Enhancement of product durability and usability for resource-efficient society

Development of material design and evaluation system improving long-term reliability of CFRP laminates

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Objective:

In the present research, in order to evaluate and predict the long-term reliability and fatigue life of CFRP, we propose a new “remaining life parameter” determined by the deformation mode, load history, deformation history, damage degree of the material.

Summary

Since the mechanism of damage and fracture of CFRP is extremely complex, "passive design" has been employed overestimating the safety factor and estimating the remaining life extremely short. If the remaining life of CFRP can be estimated appropriately, it will be possible to further reduce the weight of automobiles and aircraft, resulting in a reduction in CO_2 and NO_x emissions. In the present study, we clarified the effective factors that determine the remaining life of CFRP and evaluate the influence of the factors, which are load state, load history, damage level, deformation mode, and so on, affecting on the remaining life. Using the finite element method and molecular dynamics method, the damages and fracture mechanisms from the micro/macro level of CFRP structures is investigated assuming actual structures, Furthermore, the knowledge for obtaining a long-life material is also clarified.

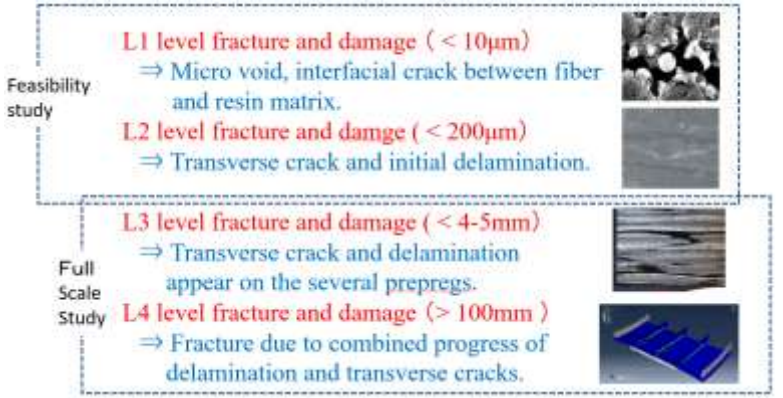

Fig.1 Fracture/damage of CFRP treated in the present study.

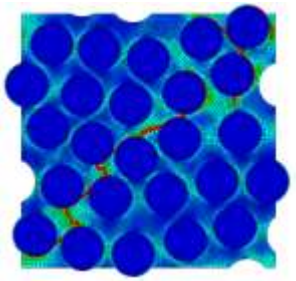

Fig.2 Damage propagation of CFRP obtained by FE analysis.

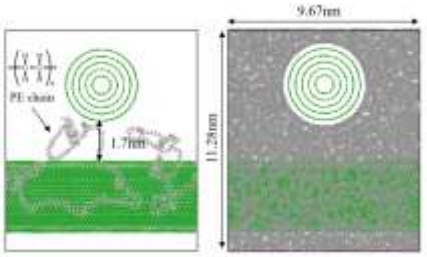

Fig.3 Numerical Analysis of molecular dynamics.