Parameters in the Expression of Fatigue Crack Growth Rate (In the Light of Crack Energy Density)
Katsuhiko WATANABE* and Makoto ITO**

Previously, a general expression of fatigue crack growth rate was derived by one of the authors, based on the concept of crack energy density. In this paper, the meanings of that expression and the parameters of which that expression is composed are considered; and the meaning of conventional expression like the law of Paris is also made clear. Experiments of fatigue crack growth and finite element analyses corresponding to these experiments are carried out to influences of the differences of material, type of load and crack length or the like on the parameters and crack growth rate are discussed based on the results and it is verified that such influences can be evaluated by the general expression above. It is also pointed out that, if the constitutive relation of the material is given, it may be possible to evaluate the growth rate as well as the influences of various differences.

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Dependence of Threshold Stress Intensity Factor Range $\Delta K_{th}$ on Crack Size and Geometry and Material Properties
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The dependence of $\Delta K_{th}$ on crack size and geometry, and Vickers hardness $H_V$ under stress ratio $R = -1$ was studied. The effects of crack size and geometry are unified with a geometrical parameter $\sqrt{\text{area}}$ which is the square root of the area occupied by projecting defects or cracks onto the plane normal to the maximum tensile stress. The dependence of $\Delta K_{th}$ on $\sqrt{\text{area}}$ is expressed by $\Delta K_{th} \propto (\sqrt{\text{area}})^{1/2}$ and that of $\Delta K_{th}$ on $H_V$ is expressed by $\Delta K_{th} \propto (H_V + C)$. For small cracks and defects with $\sqrt{\text{area}} \leq 1.000 \mu m$, the following equation for predicting $\Delta K_{th}$ and the fatigue limit $\sigma$ are available: $\Delta K_{th} = 3.3 \times 10^{-3}(H_V + 120)(\sqrt{\text{area}})^{1/2}$, $\sigma = 1.43(H_V + 120)(\sqrt{\text{area}})^{1/6}$ where the units in these equations are $\text{MPa}: \text{m}^{1/2}$, $\sigma: \text{MPa}$, $\sqrt{\text{area}}: \mu \text{m}$. For cracks and defects with $\sqrt{\text{area}} > 1000 \mu m$, the dependence of $\Delta K_{th}$ on crack size gradually changes from $(\sqrt{\text{area}})^{1/2}$ to $(\sqrt{\text{area}})^n$ and this causes the difference in the exponent $n$ in the equation of the type $\sigma = C$ which was first obtained by N.E. Frost, and was confirmed later by other researchers. Although the tendency of many data indicates that there may be a linear correlation between $\Delta K_{th}$ for a large crack and $H_V$, more systematic studies are necessary to establish the exact relationship between $\Delta K_{th}$ and $H_V$.

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Dynamic Interaction between Penny-Shaped Cracks in an Infinite Solid
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This paper deals with the dynamic interaction between penny-shaped cracks in an infinite solid. Laplace and Hankel transforms are used to reduce the mixed boundary value problems to a set of dual integral equations. The solution is expressed in terms of a Fredholm integral equation of the second kind having a kernel with fast rate convergence. A numerical Laplace inversion technique is used to recover the time dependence of the solution. The dynamic stress intensity factor is determined and its dependence on time and the geometry parameter is discussed.

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