

Introduction and Application of CED-based Fracture Mechanics

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The CED (Crack Energy Density) [1] is introduced as the crack parameter which has the meanings of strain energy density per unit area for a completely sharp crack as the limit where the notch radius approaches zero in a notch model. The CED can be defined in an arbitrary direction at a crack tip and is a potential parameter for describing fracture behavior of a mixed-mode crack. It has also been expected as a crack parameter which controls fracture behavior in different material media. The CED in an arbitrary direction is often evaluated by path-independent region integral or load-displacement curves. However, there is the need to compute stress and strain near crack tip even in elastic stage and this makes us uneasy to find the numerical result of the CED. On the other way, we can get relative accurate numerical result of CED through load-displacement curves, but it is not so clear about the difference between the two evaluations.

In this report, by introducing basic concepts and potential applications of CED-based fracture mechanics, it is shown that the CED in an arbitrary direction of a crack in an inhomogeneous material under monotonically increasing load can be evaluated by a new path-independent integral, including the case of the evaluation of CED by load-displacement curves. The new evaluation can also be expected to obtain practical accuracy about the CED and useful to evaluate CED in an arbitrary direction of a crack. Through the new evaluation, it also becomes to be clear about the difference between the evaluations of CED by path-independent region integral and by load-displacement curves.

Keywords: Crack Energy Density; mixed-mode crack; fracture mechanics parameter; path-independent integral

Reference

[1] Watanabe, K. : *New Proposal of Crack Energy Density Concept as a Fundamental Fracture Mechanics Parameter*, **Bulletin of the JSME**, **24(198)** (1981) pp. 2059-2066.