THE SELECTION RATIO OF CRACK PROPAGATION IN COMPOSIT MATERIALS BY METAL

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A crack growth in composite materials by metal might be expected to show the strong dependence on the strength ratio (Hardness ratio) of constituent microstructure. The crack growth for high hardness ratio is dominated by cleavage cracking of ferrite grains according to the increasing of stress intensity factor. So, selection ratio of crack growth would be expected to result in an increase. Also it will be expected that the selection of crack growth for ferrite is admitted at the low hardness ratio. This will be seemed to come from the decreasing of the plastic deformation constraint due to the second phase; consequently crack growth is easily done in the ferrite matrix phase by striation.

In order to develop the composite material microstructure (it is abbreviated Co) having ferrite encapsulating islands of material 。 Quntitative metalgrafic techniques were employed to determine the ferrite grain size. The volume fraction of martensite, the size of the martensitic structure. In order change only martensitic hardness, Co, material as 470 K, 670 K, and 870 K. (They are abbreviated C2 and C4, and C6 respectivity) Fig .1 show the martensitic hardness comparison between Co, C2, and C6.

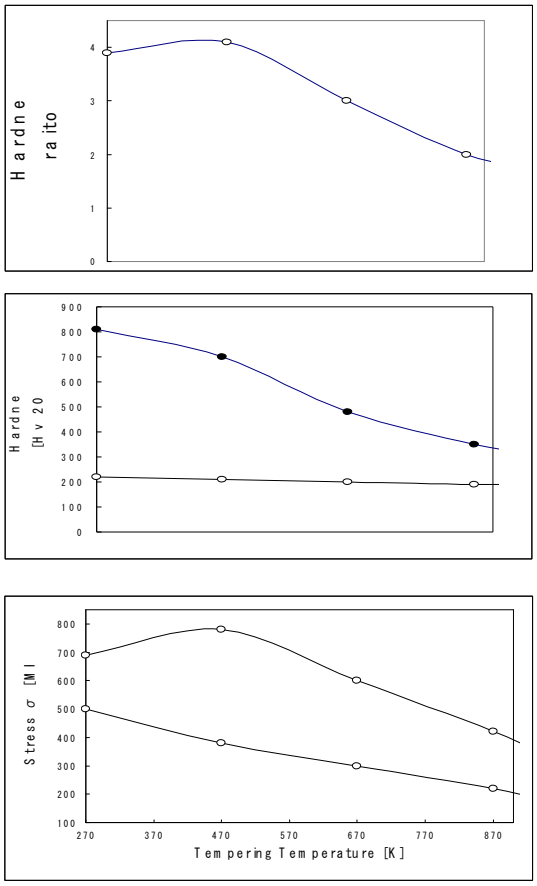

Fig.1 Relationship among hardness raito, stress and tempering temperature

.Ferrite selection ratio S (%) of fatigue crack path as follows: S (%) = {Lf ／ (Lf +Lm)}*100 %

Where Lf: Crack length which propagated by using above depending on stress intensity factor, delta K. Incase of lower strength ratio, between martensite and ferrite, the dependence factor is not recognized. But in case of higher strength ratio the selection ratio of crack growth results in an increase according to the stress intensity factor. At delta K 17 Mpa, fatigue crack propagates mainly by striation mechanism at

each material as in Fig. 2.

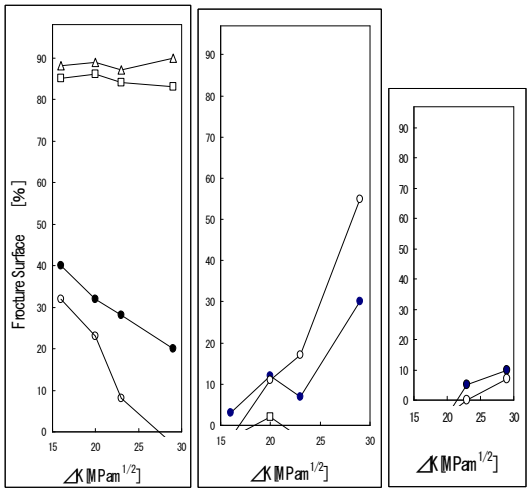

Fig.2 Various fracture surface percent

But this tendency of each material changes according to the increase in the intensity factor .In case of lower stress at crack tip, the slip deformation at Co and C2 materials occur with martensite and ferrite because of high plastic deformation constraint. The ferrite selection ratio crack becomes lower according to the increasing. On the other hand, incase of high stress at crack tip, slipping at crack tip gives the influence on the other hand martensite and its influenced area becomes larger. But crack propagation with striation material Co and C2 gradually increase and propagation with cleavages cracking gets a priority. That is to say, ferrite selection ratio in case of higher stress at crack tip increase depending on the growth of crack. Slip deformation at crack tip at material C4 and C6, which their plastic deformation constraint factor lower occur easily because plastic deformation constraint by martensite is in decrease as compared with material Co and C2. So, crack propagates thru ferrite by striation mechanism having no relation with delta K. We would like to discuss the cause of difference of ferrite selection ratio ratio as shown in Fig 3.

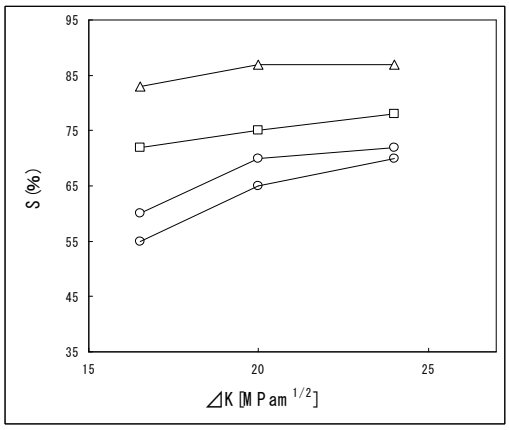

Fig.3 Ferrite selection ratio of crack path

The hardness of C6 shown 250 .The difference between this 250 Hv and 240 Hv at ferrite of Co is very small and hardness ratio shows lowest value . Therefore, plastic deformation constraint is not recognized. So, it is expected that slip deformation will be occur than that of C4 and uniformity slip deformation concentrating ferrite will be increase according with increase in delta K.

(1) : In case of high plastic deformation Constraint, the dominant case of ferrite selection ratio by fatigue crack caused by plastic constraint. (2) : In the case lower plastic deformation constraint , ferrite selection ratio caused by slipping deformation of ferrite . (3): The crack propagation speed depends on not only the difficulty of slip deformation at the crack tip but also plastic deformation constraint of ferrite by martensite.

Reference(1) :T.Ishihara ,JSME,10231028,46-4 10,(1980)