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The complexity of SCC (stress corrosion cracking) behavior arises from the fact that the phenomena involve mechanical (due to the stress field) and electrochemical (due to the envirnoment) driving forces together with their interactions. Separation of these two major influences is difficult, still critical for the evaluation of proposed models. Specifically, this report is concerned about the use of the acoustic emission technique during a SCC investigation of titanium-alloys in 3.5% NaCl. In principle, the basic contribution that might be expected from the acoustic technique is along the question as to whether or not the transgranular cleavage process involved continuous growth. That is, any "brittle crack" steps during the slow crack growth process would emit elastic stress waves which could be acoustically detected. Experiments are being performed on Ti-8-1-1, Ti-5-2.5 alloys (α/β structure) and Ti-13-11-3 alloys (all β structure) in an annealed condition. Fatigue pre-cracked notch specimens with a thickness of about 0.125 inch are being tested under constant load. Specimen geometries also include the contoured double-cantilever beam specimen ($K \simeq$ constant) instrumented with a crack-opening displacement gage and a piezoelectric transducer. These provide slow-crack rate determinations and stress wave recordings. The amplification set-up for the stress-wave emission (SWE) was of about 60,000 gain and a pass-band frequency between 30 KHz and 48 KHz was used to filter out mechanical noise.

The experimental results showed that environmental crack growth was accompanied by stress-wave emission. Furthermore, the stress wave activity had a clear correlation with the slow crack growth rate. Figures 1(a) and 1(b) show the crack propagation rates and SWE/sec as a function of the applied stress intensity factor (K_i). Figure 1(c) shows one of the more active portions of the monitored stress waves in a single-edge-notch specimen. Here K is a monotonically increasing function (for constant load) with crack length and the stress wave amplitudes as well as the frequency of emission increase as the crack extends or as K is increasing.

From the size of the stress-waves observed, estimation of the microcrack extensions could be made based upon a semiempirical approach described elsewhere.[1] It was concluded that at high K_i the amplitude of each stress wave represented the amount of energy that could be associated with an extension on the order of a grain size in dimension. This strongly supports a discontinuous model[2] of a triggering event followed by a cleavage jump process. It does not, however, invalidate the electrochemical interpretation as this still might be the thermally-activated mechanism which controls the triggering process. Also, a sufficiently large number of SWE to account for all of the crack growth was not observed so that electrochemical dissolution might even play a significant role with respect to crack growth.

Consequently, three points should be emphasized. First, a partially discontinuous model involving cleavage jumps can suggest a more meaningful explanation of the high crack propagation rates observed. As was proposed by Powell and Scully,[3] this discontinuous model is also suggested by fractographic evidence of the cleavage process. Secondly, the role of microstructure, such as grain size, ordering and second phase effects, might be incorporated into the model by analyzing the number and size of jumps. Finally, temperature effects in terms of apparent activation energies could be better analyzed since the acoustic technique can provide a measure of the average velocities on a fine scale in terms of the distance increment and the time increment. Use of the Arrhenius rate equation for the reinitiation of the crack can be best interpretated if estimations of the inhomogeneous jump distances and time intervals are available.

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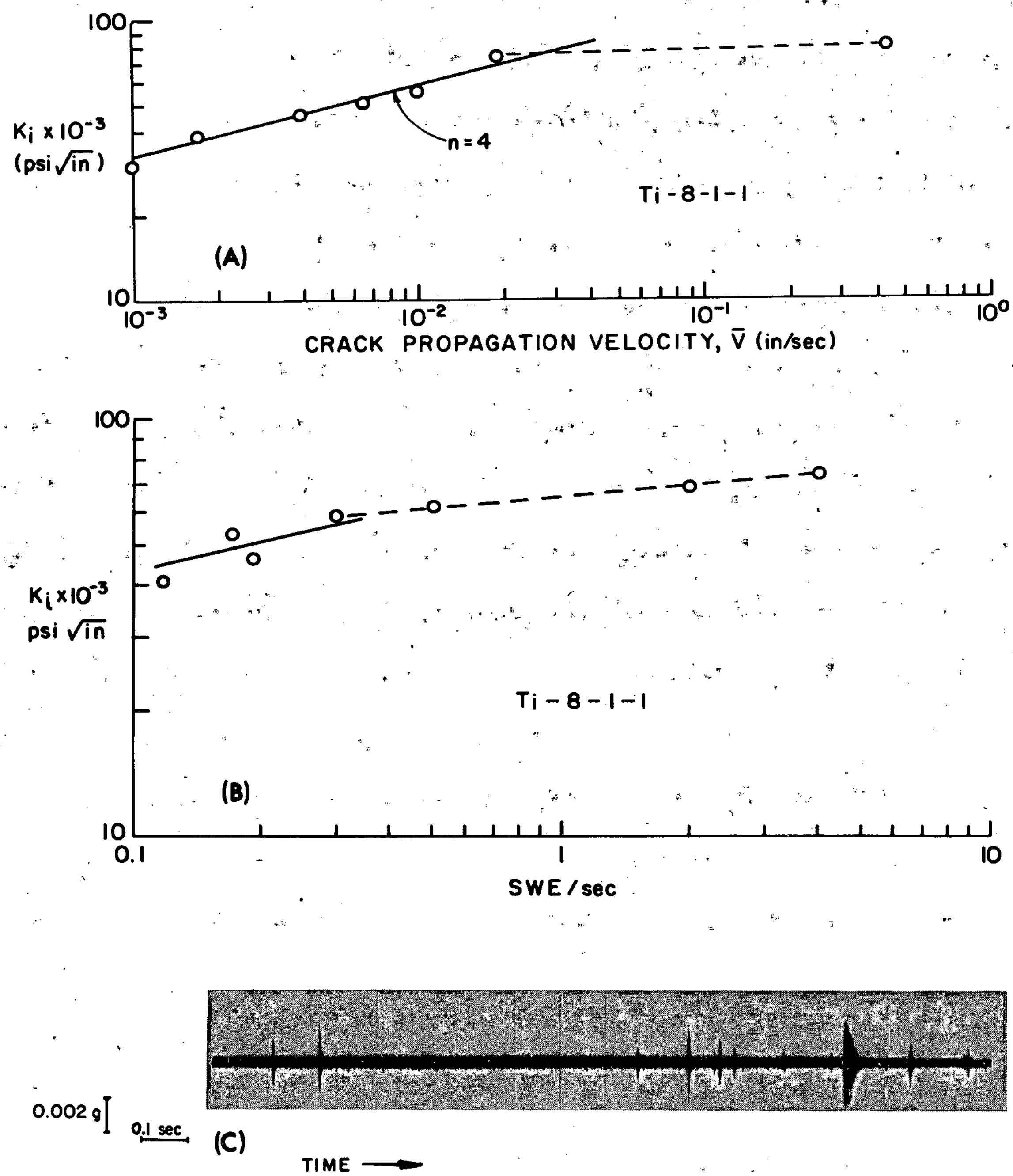

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Fig. 1