Unified description of short fatigue crack growth

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The kinetics of fatigue crack growth is traditionally described as a function of stress intensity factor amplitude (K_a) and evaluated by the Paris-Erdogan law, assuming negligible plasticity around the crack tip. In low cycle fatigue conditions, this small-scale yielding criterion is often not satisfied, and the prediction of crack growth based on K_a is non-conservative [1,2]. We repeatedly found that in such case, the amplitude of plastic part of the J integral ($J_{a,pl}$) can be used as a quantity governing the kinetics of the short crack growth [3]. It means that the data of crack grow rate, da/dN, measured at various loading levels, fall on a single curve. Moreover, data from various alloys, from relatively soft Al alloy to strong ODS steels, overlaps, too [3]. Finally, the same crack growth rate, if plotted versus $J_{a,pl}$, is found for different loading modes, specifically axial, torsional and in-phase axial/torsional loading [4].

Keywords: fatigue crack, stress intensity factor, J-integral, multiaxial fatigue

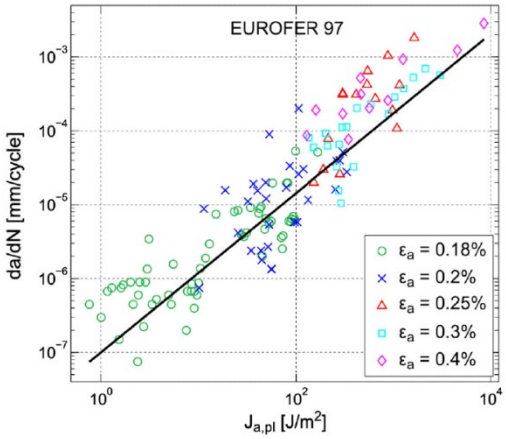

Fig.1 Crack growth rate in specimens loaded with various strain amplitudes

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