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The propagation of short cracks near individual microstructural features studied in situ

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For most metalworking tools, cutting-edge loads fluctuate at high levels during the industrial application, leading to material fatigue and tool failure. Usually, fatigue crack propagation is observed on cracks emanating from large, through-specimen-width notches that average a large number of microstructural features along the crack front, which does not represent reality. To address the lack of appropriate methods to monitor the propagation of application-relevant microstructurally short cracks a novel method is proposed: The technique enables in situ measurement of microstructurally short cracks emanating from an artificial defect of application-relevant size near a small number of microstructural features by use of the alternating-current potential drop method. The current work demonstrates the technique on the example of µm-sized semi-elliptical notches introduced via focused ion beam milling into industrial-grade high-speed steel. The propagation of microstructurally short cracks near systematically varied microstructural features was monitored. The fatigue crack extensions calculated based on the in situ measured current signals showed good agreement with fractographs made after the test specimens' final fracture.

Speaker Country

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