

Ultra high cycle fatigue of thin Al-based films



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(Lauren Quitzon)

ULTRA HIGH CYCLE FATIGUE OF THIN AL-BASED FILMS

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Shaker Verlag Jul 2010, 2010. Buch. Condition: Neu. Neuware - Fatigue is a major problem in several application fields. The common basis is that samples can fail even far below their tensile yield stress limit when stressed cyclically. Fatigue describes the degradation of material properties due to the cyclic application of a mechanical load. In surface acoustic wave (SAW) devices the frequency of the cyclic stress can reach the GHz-regime. Cycle numbers of 10¹⁴ can therefore be reached within one day. Hence cycle numbers greatly surpass those seen in common applications. The working principle of SAW filters is based on the back and forth transduction of an electric signal to a mechanical wave. An alternating current is applied to the device and an acoustic wave is induced by the piezoelectric substrate. As the device is designed to operate as resonator, locally high stresses can occur. Fatigue damage can be observed in SAW devices, which leads to a degradation of their properties. A lifetime criterion defines when the degradation is considered a device failure. An easily accessible criterion is the resonance frequency of the device. The damage formation in SAW devices is attributed to a combined effect of dislocation motion and stress-induced diffusion processes. The complex stress distribution in the device is dominated by shear stresses induced by the surface acoustic wave. The similarity of the damage observed in electromigration with voids and extrusions and the damage observed in SAW test devices, led to the name 'acoustomigration' since the damage formation is triggered by a surface acoustic wave. While many materials have been tested empirically, few studies have tried to unveil the underlying mechanisms. The major goal of the research presented in this thesis is to achieve a deeper understanding of the fatigue mechanisms in the GHz-regime and, based on...

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