



## Sonderforschungsbereich 595 Elektrische Ermüdung in Funktionswerkstoffen



TECHNISCHE  
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### Fracture mechanics of piezoelectric and ferroelectric materials

Today, functional ceramics cover widespread applications in modern technical areas like mechatronics, smart structures and microsystem technology, where they serve as sensors or actuators. Under service conditions, these piezoelectric and ferroelectric materials may be exposed to severe static, cyclic and dynamic electrical as well as mechanical loading. Due to their intrinsic brittleness, problems of fracture and reliability have to be solved. During the last decade, fracture mechanics of piezoelectric and ferroelectric materials has been investigated rather intensively. Among much progress, there are many open questions left. Moreover, it was realized that cracks in piezoelectrics show more complicated, unexpected features:

Most of all is an inherent coupling of electrical and mechanical fields at the crack tip.

Piezoelectric materials are in general anisotropic, which makes the results dependent on crack orientation.

Real cracks are filled with a dielectric or conducting medium, which has to be accounted for.

Piezoelectric devices are operating under cyclic or pulse-like current, causing fatigue and severe electrically induced impacts.

The observed fracture behavior gives no unique picture. There exists no universal fracture criterion up to now.

For non-linear ferroelectric hysteresis behavior the fracture mechanics concepts are still in the beginning.

The better understanding of domain switching processes in the crack tip process zone seems to be the key point for further progress.

The presentation will give an introduction and overview of fracture mechanics in piezoelectric and ferroelectric materials. Special emphasis is given to fracture mechanics parameters and fracture criteria for stationary cracks under coupled electromechanical loading. Attention is paid to numerical solutions of fracture experiments and to simulation of non-linear domain phenomena in the fracture process zone.

Die Vortrag findet um **16:15** im Gebäude der Materialwissenschaften,  
Lichtwiese, Petersenstr. 23, **Raum 77** statt