A New Fracture Toughness Test for Ceramic Discs and Plates
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Components and specimens for B3B-KIc-test

Knoop Indenter

Fracture surface with Knoop indentation crack, fluorescent dye

Test set-up of the B3B-KIc-test

Measurement of dimensions of the starting crack

Components or specimens produced during material development are often too small to machine standard specimens for KIc-testing (3 × 4 × 45 mm³) out of them.

Material properties of ceramics depend on consolidation and sintering conditions. On large specimens (often fabricated separately) differing properties are determined.

**WANTED:** a test method for fracture toughness applicable to small material pieces

**Experimental Method**
- Introduce starter crack with Knoop indenter
- Grind off deformed zone
- Fracture specimen in B3B-test
- Calculate fracture stress $\sigma_{B3B}$ from maximum force
- Measure crack size $(a, c)$ on fracture surface
- Calculate Max$(Y_A, Y_C)$
- Evaluate $K_{IC}$

**Sources of Error**

- Crack orientation
- Crack location

**Motivation**

- Components or specimens produced during material development are often too small to machine standard specimens for $K_{IC}$-testing (3 × 4 × 45 mm³) out of them.
- Material properties of ceramics depend on consolidation and sintering conditions. On large specimens (often fabricated separately) differing properties are determined.

**Parametric Evaluation of the Stress Intensity Factor**

$$K_{IC} = \sigma_{B3B} \sqrt{\frac{\pi a}{c}}$$

$$Y_{A,C} = Y_{A,C} \left( \frac{a}{c}, \frac{t}{R}, \frac{R}{R_{B}}, \nu \right)$$

- Fitted expression for $Y_A$ and $Y_C$

**Verification**

- Small measurement error
- Precise evaluation of $Y$ using FEM
- Formula for $K_{IC}$ evaluation available [1]
- Variable specimen sizes, also small specimens possible
- Variable specimen shape possible: round discs or rectangular plates
- Can be applied directly to components (electrical resistors, PTCs, ...) or to specimens taken from components

**Conclusions**

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- Precise evaluation of $Y$ using FEM
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**Publications:**


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