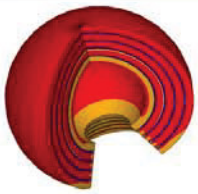
Multilayered ceramics to improve reliability of structural components



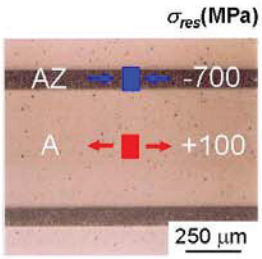
Investigation of the fracture behaviour, fatigue resistance and thermal shock response of layered ceramics designed to improve reliability of structural components.

Keystone: internal layers with high compressive residual stresses.

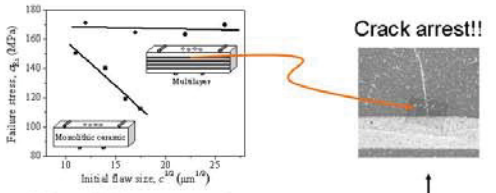
Multilayer design: thick layers of alumina (A) and thin internal layers of alumina-zirconia (AZ).

Material processing: sequential slip casting of stabilized colloidal slurries.

Residual stresses: due to the t->m zirconia phase transformation in the internal layers during sintering.



Fracture behaviour



Crack arrest!!

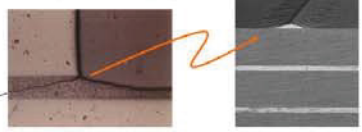
Monolithic ceramic: strength dependence with initial flaw size

Multilayer: constant failure stress

(threshold strength) → **Higher reliability!**

...plus

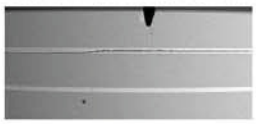
Mountain-like fracture due to crack bifurcation



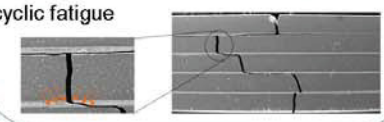
Crack growth resistance → **Higher toughness!**

Fatigue resistance

Thin compressive layers absorb damage and structure underneath remains intact



Reinforcement mechanisms such as crack bifurcation are also active under static and cyclic fatigue

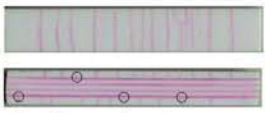


Thermal shock response

Monolith

Crack degradation due to rapid temperature change

Laminate



Crack arrest under severe thermal shock conditions

Main results

- Internal layers in compression control fracture
- Higher reliability and toughness due to crack arrest
- Enhanced fracture energy through crack bifurcation

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Zur Person:

- Born in Burgos, Spain, in 1975.
- Mechanical Engineering degree at the University of Valladolid, Spain. Final project in Biomechanics at SDSU, San Diego, USA.
- PhD in Materials Science at the Technical University of Catalonia (UPC), Spain.

Forschungsschwerpunkte:

- Processing of layered architectures with tailored residual stresses.
- Microstructural characterization and mechanical testing of brittle materials.
- Strength and fracture behaviour of layered composites.
- Finite element modelling and analysis of structural components.

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