2.15 Specification of a micro-transgranular fracture parameter

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Aim of the project

- Measuring experimentally the **micro-transgranular** fracture parameter (energy release rate) is an open issue.
- Experimentally possible to measure the transgranular fracture **percentage** in a long main crack.
- Calibration of micro-transgranular by **efficient** numerical simulations knowing the micro-intergranular parameters.

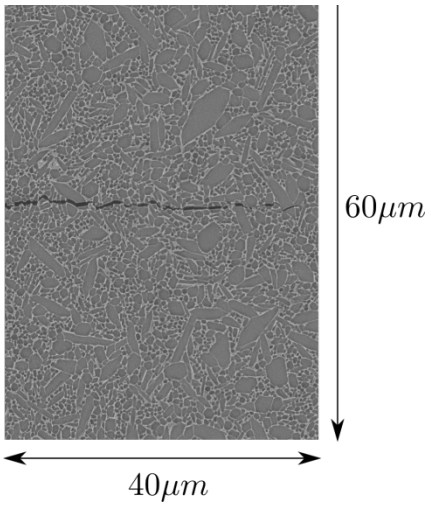

*Figure 1: The crack produced by an indenter in Si_3N_4. (number of grains = 2300, measured transgranular percentage = **40%**, micro-intergranular G_c = 15.8 J/m)*

Approach

- Dynamic insertion of cohesive elements in explicit time-integration scheme with a **scalable parallel** library.
- Using **graph** algorithms such as connected component and depth first search to extract the main crack from a crack pattern.
- Parametric studies on micro-transgranular G_c.

Future work & Valorisation steps

Studying the mechanical fracture parameters and simulation of the ball indentation with current simulation tool including frictional contact.

Project Progress (in years)

1	2	3	4

Challenges

- **Problem size:** main crack size and grain numbers should be comparable to experiment.
- **Dynamic loading:** extract and analysis of dynamic crack pattern.
- **Number of simulations:** many simulations are required to calibrate the data.

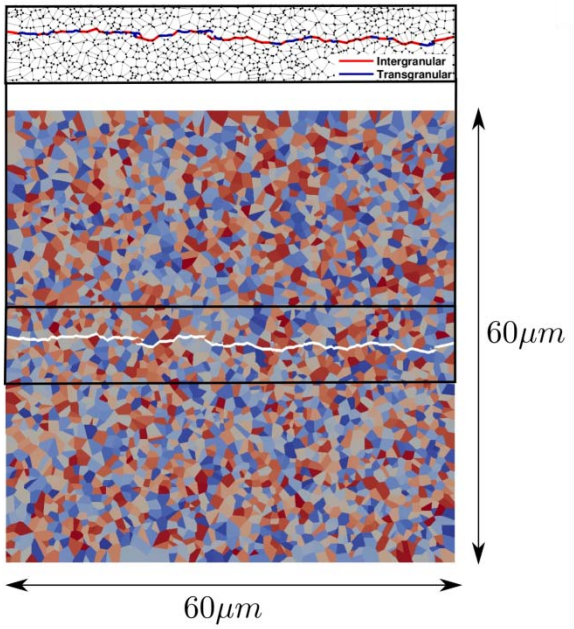

*Figure 2: Numerical simulation of dynamic crack propagation in Si_3N_4. (number of grains = 3200, loading rate = $5*10^3$/s, number of processors = 104), the window shows the graph representation of the main crack with **40%** of transgranular fracture.*

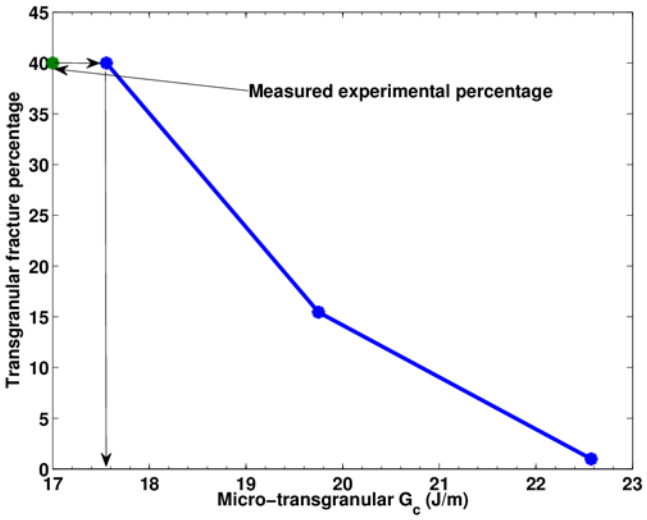

Figure 3: Simulation results for different micro- transgranular G_c, G_c = 17.27 J/m corresponds to the 40% measured transgranular percentage.

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