2.17 Dynamic indentation induced damage in silicon nitride

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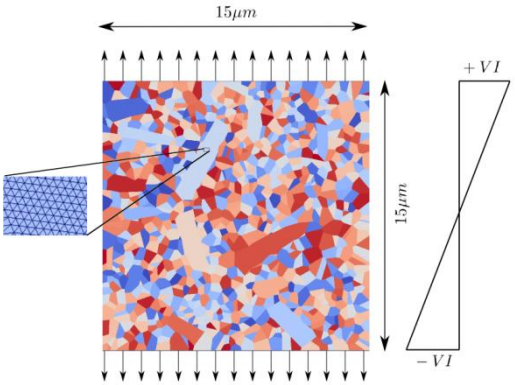
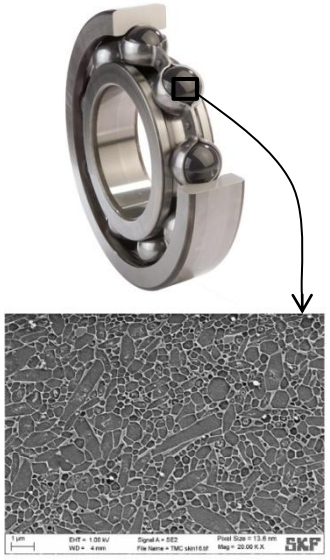
Aim of the project

Using silicon nitride in roller bearings improved the toughness of this industrial tool compared to metalic ones. The aim of this project is to improve our physical understanding of micro-scale damage mechanisms by conducting numerical simulations in view of increasing the macroscopic toughness.



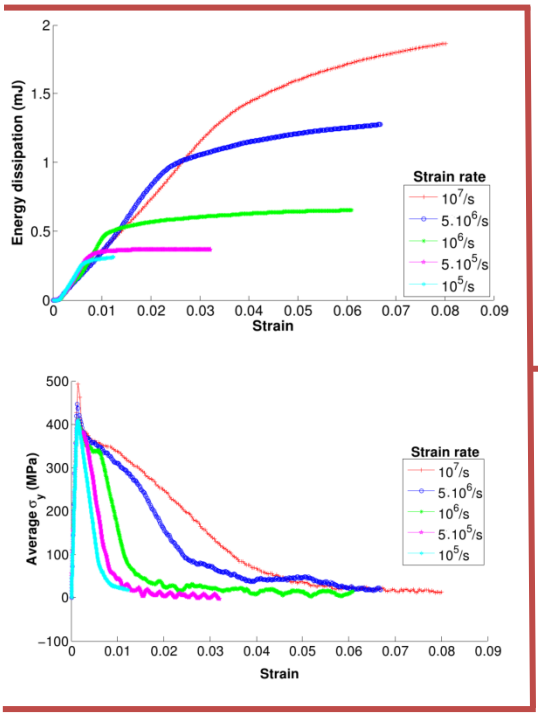
Approach

- Using **cohesive elements** in **finite element** framework
- Simulating regular grains by **Voronoi tesselation**
- Merging grains for considering **needle-shaped grains**
- Transgranular fracture are propagating along **cleavage planes** by aligning the mesh inside the grains with these planes



Parametric studies

Strain rate



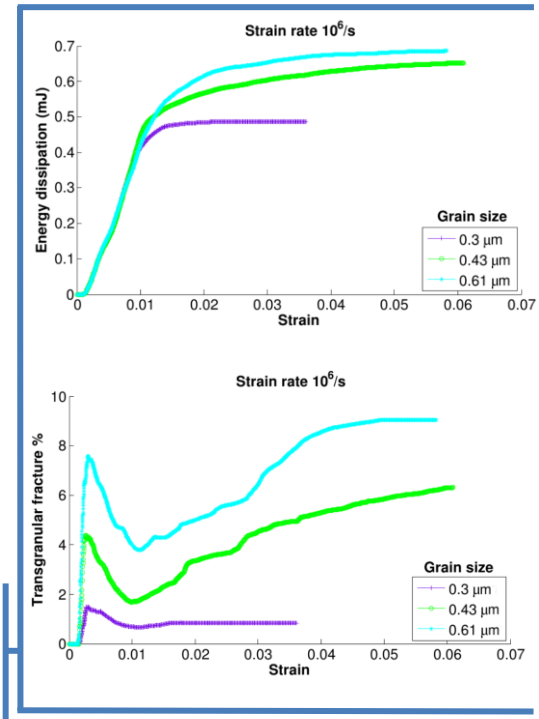
I. Increases percentage of transgranular fracture justify more energy dissipation for higher strain rate
II. Inertia effect and transgranular fracture properties cause rate hardening

Boundary conditions

- Imposig displacements on top and bottom edges with a specified strain rate
- Imposing a ramp velocity to prevent the inertia effect

I. Increases percentage of transgranular fracture and more turtuous crack path cause higher toughness for specimen with larger grains

Grain size



Valorisation steps

Project Progress (in years)

1	2	3	4

Future work

I. Develop an analytical model to specify the toughness based on the geometrical parameters
II. Consider frictional contact between crack surfaces

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