

## Can we measure plastic strains at the nanoscale?

**Citation for published version (APA):**

Vermeij, T., & Hoefnagels, J. P. M. (2019). *Can we measure plastic strains at the nanoscale?*. Poster session presented at Mate Poster Award 2019: 24th annual poster contest, Eindhoven, Netherlands.

**Document status and date:**

Published: 01/12/2019

**Document Version:**

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

**Please check the document version of this publication:**

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

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# Can we measure plastic strains at the nanoscale?

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## PROBLEM

- Deformations in **Advanced Steels** at small scales are hard to measure and quantify

## GOALS

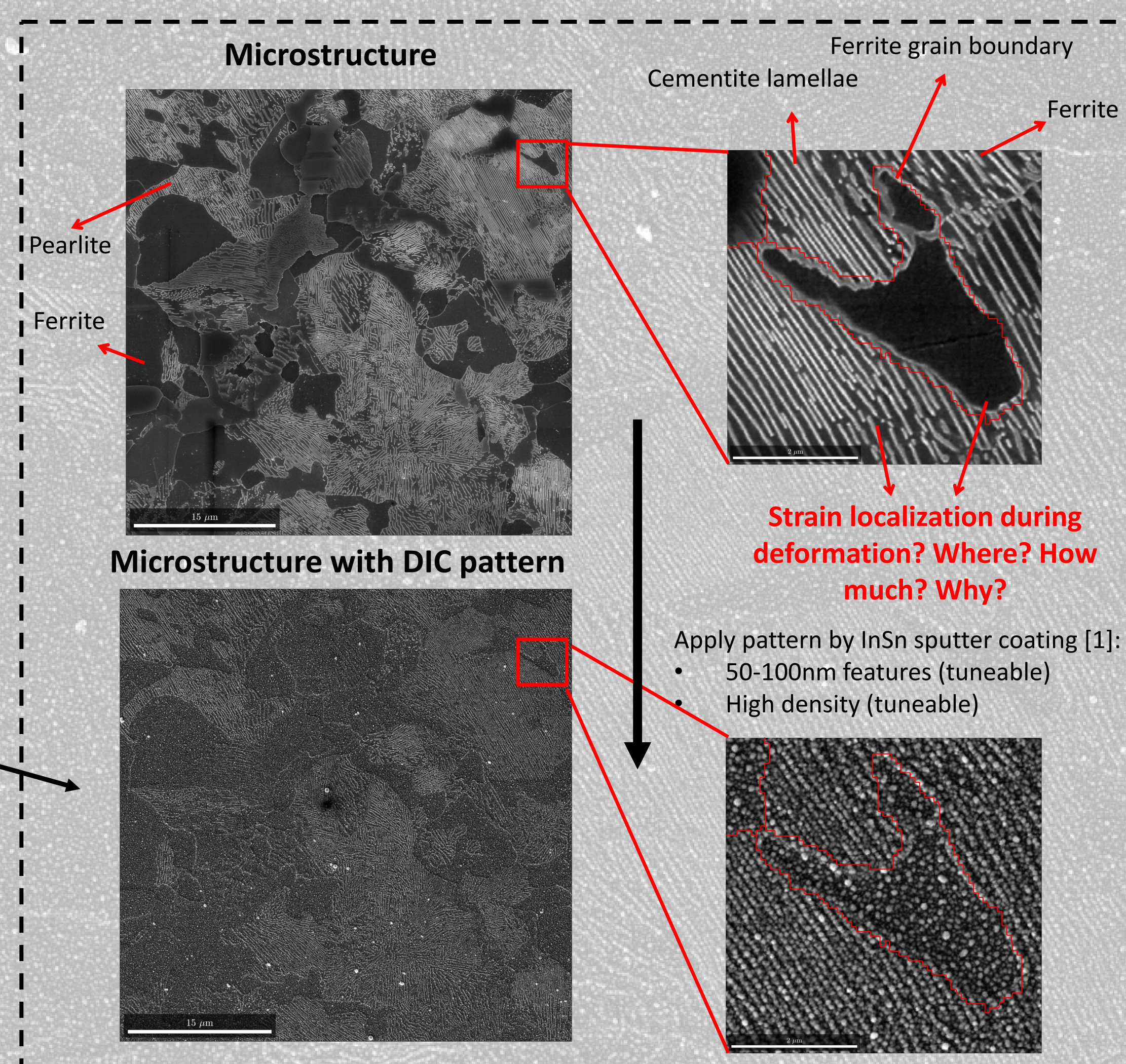
- Measure plastic strains in steel microstructures at high spatial resolution:
  - Retrieve strains over a large area ( $>50 \times 50 \mu\text{m}^2$ )
  - Attain high spatial resolution at the nanoscale
  - Robustness to high strains
  - Allow direct comparison to the microstructure

## HOW?

- High-Res Digital Image Correlation (DIC)
  - Apply a dense random pattern with nanoscale features [1]
  - Image pattern during deformation in the SEM
  - Attain high-resolution strain measurements at the nanoscale [1]
  - Retain robustness to high strains [1]
  - Align microstructure & strain fields

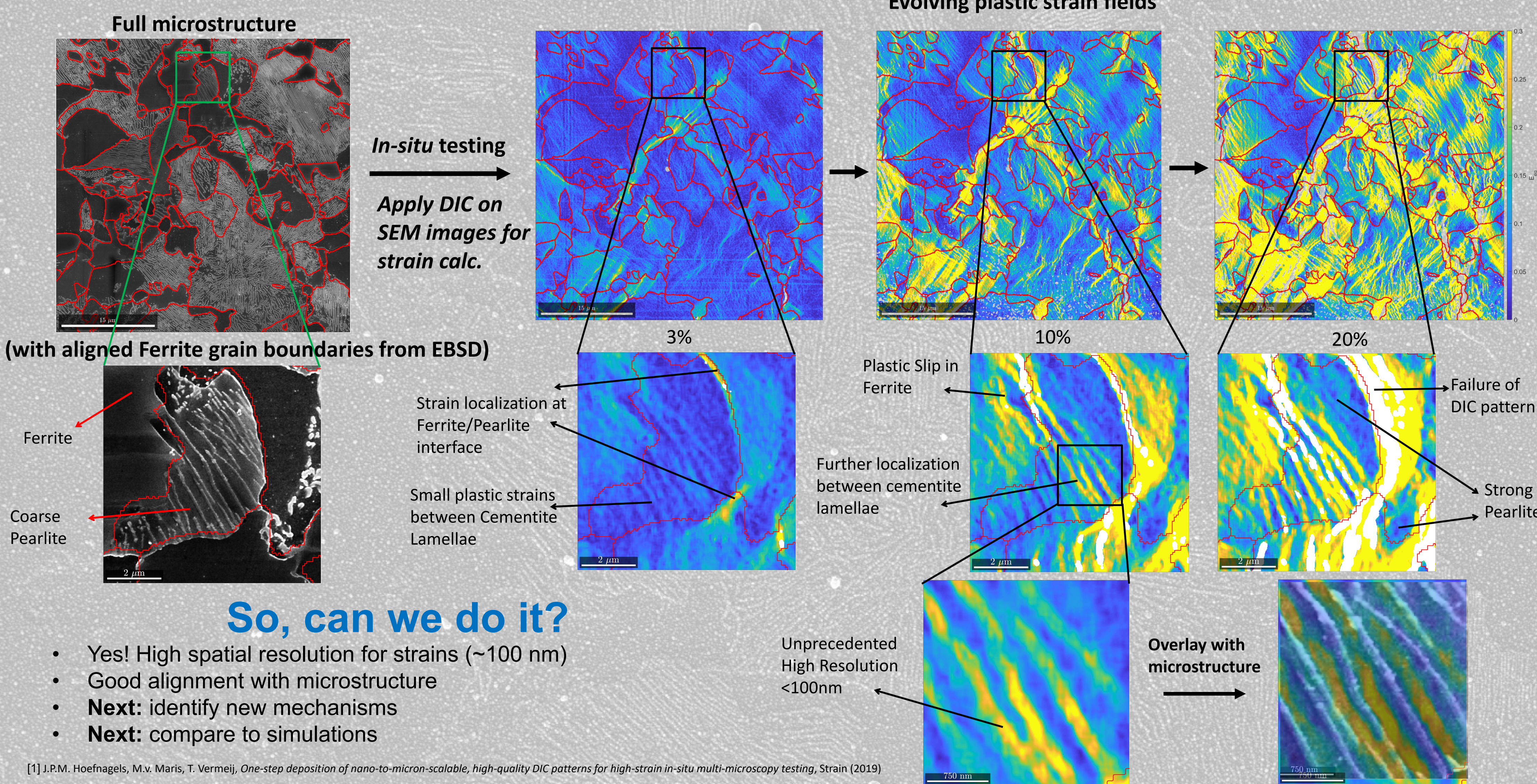
## RESULTS

- High-Res plastic strains



Perform DIC on *in-situ* tensile test in Scanning Electron Microscope

Evolving plastic strain fields



## So, can we do it?

- Yes! High spatial resolution for strains ( $\sim 100 \text{ nm}$ )
- Good alignment with microstructure
- **Next:** identify new mechanisms
- **Next:** compare to simulations

[1] J.P.M. Hoefnagels, M.v. Maris, T. Vermeij, One-step deposition of nano-to-micron-scalable, high-quality DIC patterns for high-strain in-situ multi-microscopy testing, Strain (2019)