PROZESS SIGNATUREN

TRANSREGIONALER SONDERFORSCHUNGSBEREICH 136

University of Bremen

RWTH AACHEN UNIVERSITY

GFE GEMEINSCHAFTSLABOR FÜR ELEKTRONENMIKROSKOPIE

Analysis of workpiece modifications by high resolution microstructure characterization

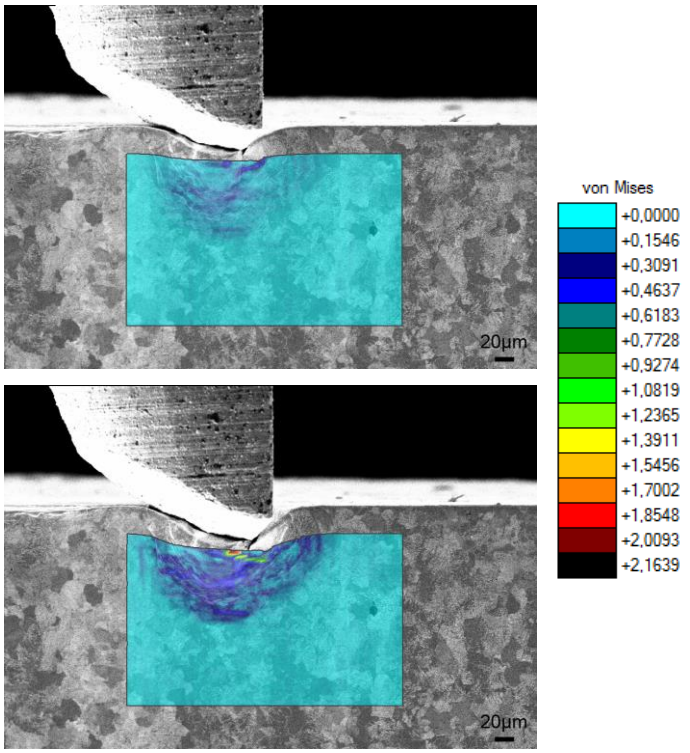
Project C02/ Electron Microscopy – Prof. Joachim Mayer

Objective and approach

Project C02 investigates the influence of internal loads and the resulting surface modifications qualitatively and quantitatively through the combination of different characterization methods like high resolution SEM and TEM investigations and analythical methods like EBSD and EPMA. Determination of surface modifications allow conclusions on internal loads. Direct observation of in situ experiments in the large chamber SEM allows a deeper understanding of the underlying mechanisms. The generated data can be used in cooperations with other F- and M-projects to validate simulation results and to build Process Signatures.

Current state of knowledge

In cooperation with F08 the turning process is analysed by in situ experiments in the LC-SEM. First results show clearly the mechanical deformation of the rim zone in the cross section. Digital image correlation of the acquired SE images allow the determination of von Mises strains that can be compared with the simulated data of project F08. A characterization of the cross section before and after the in situ experiments allows a comparison of experimental determined and simulated microstructure modifications of M03. However, the experiments also revealed the complexity and challenges of these investigations, as small imprecisions in µm range of positioning sample and chisel influence the experiments massively.



Conclusion and further procedure

With the help of in situ experiments, simulated internal loads and characterization of generated modifications of the surface microstructure a more profound knowledge of the mechanism of dynamic recrystallization is possible but also the establishment of a Process Signature Component shall be possible, that correlates strain/ strain rate with grain sizes.

Publications

[Are18] A. Aretz, L. Ehle, et al., Ultramicroscopy 193 (2018), p. 151-158; https://doi.org/10.1016/j.ultramic.2018.07.002.
[Ehl18] L. Ehle et al., Procedia CIRP 71 (2018) p. 341-347; https://doi.org/10.1016/j.procir.2018.05.038.
[Ehl20] L.C. Ehle et al., J. of Mat. Proc. Techn. 280, (2020), https://doi.org/10.1016/j.jmatprotec.2020.116596.
[Ehl21] L.C. Ehle et al., Mat. Sci. and Eng. Techn., eingereicht 27.04.2021.
[Ehl21] L.C. Ehle et al., Mat. Today Comm., 2nd revision 12.04.2021.