



Contribution ID: 31

Type: **not specified**

## Diffusion processes in metals at the nanoscale: experimental studies

Cu electrodes are widely used in accelerators, for example in CLIC [1]. One of the problems arising in the accelerator is the breakdown phenomenon [2] causing damage to the accelerating structures and disturbances in the accelerated beam. The cause of the vacuum breakdowns is still under investigation and the electrodes regularly investigated for clues. According to one of the models, breakdowns can be initiated by high-aspect-ratio nanoscale protrusions that appear on Cu surface due to diffusion of Cu atoms driven by high electric field gradient [3].

In our studies, we investigate the effect of strong electric field on the behavior of various metal surfaces using nanomanipulation platform installed inside a scanning electron microscope. Our approach enables to study morphological changes in metal structures in real time with nanoscale resolution. Moreover, we investigate the consequences of vacuum breakdowns in Cu electrodes using various microscopy techniques.

[1] Compact Linear Collider (CLIC), last accessed 31 Jan 2021, URL: <http://clic.cern/>

[2] A. Palaia et al. "Effects of rf breakdown on the beam in the Compact Linear Collider prototype accelerator structure", *Physical Review Special Topics - Accelerators and Beams*, 16, 8 (2013) 081004. 10.1103/PhysRevSTAB.16.081004

[3] V. Jansson et al. "Growth mechanism for nanotips in high electric fields", *Nanotechnology* 31 (2020) 355301

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