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Spectroscopic study of high-current vacuum arcs considering anode activity

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Development of vacuum circuit breakers for high-voltage applications leads to continuous basic research in the field of vacuum arcs. Investigations of the arc plasma properties is an important instrument for understanding of basic phenomena and parameter optimization for corresponding applications. It is well known that the high-current anode phenomena have a distinct impact on contact erosion and interrupting capability, because they lead to injection of atomic vapour into the interelectrode gap causing the lowering of dielectric strength.

The contribution presents the results of optical measurements using emission and absorption spectroscopy techniques. Emphasis is put on the determination of spatial distributions of line emission from various plasma species –atoms, single and double charged ions –during different high-current modes. The driving current pulse was supplied by a high-current generator that produces an AC waveform at 50 Hz or 100 Hz at several kA maximum current. The high-current anode modes are observed by means of high-speed camera imaging and can be correlated with changes in the arc voltage. Video spectroscopy was applied during the active phase, i.e. before current zero, for determination of temporal dynamics of copper spectral lines for various anode modes –diffuse, intense, anode spot mode 1 and 2. The results show significant changes in the intensities of the atomic and the ionic Cu lines near the anode during the transition to the anode spot mode. Broad band absorption spectroscopy was used for determination of the vapour density (chromium) close to the current zero crossing and in the early post-arc phase. The temporal evolution of the Cr ground state density is presented and discussed.

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