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Updated Results of Breakdown Study for a 509-MHz CW Accelerating Cavity based on Direct In-situ Observation

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Normal-conducting RF accelerating structures are hearts of many modern accelerators, where vacuum arcs in the structures could lead to breakdowns, that might limit accelerator performance. However, we do not know what the real source of breakdowns is, i.e., the breakdown-trigger mechanism is not yet well understood.
Recently, based on direct in-situ observation method, we performed breakdown study of a normal-conducting 509-MHz continuous-wave (CW) single-cell cavity developed for SuperKEKB at KEK, and discovered that there were clear and stable bright spots on the inner surface of the cavity, which continued during high-power operation, and that such bright spots exploded and then disappeared at one-fifth of the breakdown events. We also found that a decrease in the number of stable bright spots after an explosion was a significant component of RF conditioning of accelerating structures. Furthermore, we observed sudden appearance of new bright spots shortly before breakdowns, that has stimulated our interest in the microscopic dynamics of the generation, growth, and explosion of bright spots and their correlation with RF conditioning effects and breakdown rates. Understanding the physical properties of such bright spots must be a key to elucidate the breakdown-trigger mechanism.
In this report, we present updated results of our breakdown study based on direct in-situ observation using higher-spec cameras, including spectra of the bright spots.

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