Visualization of particulates distribution from electrode erosion

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Particulates generated from electrode erosion in gas spark gap is inevitable and may initiate self-breakdown behavior with high risk. Traditionally, this problem is addressed by empirical method qualitatively. To push this old problem forward, this paper conducts laser confocal microscopy measurement of eroded surface and a statistical method is introduced to obtain visualized distribution of particulates from electrode erosion after different shots. This method allows dense particulates to be classified with their heights in z direction and scattered figures of particulates within certain height range are obtained. Results indicate that the higher-than-10μm particulates start to emerge after 200 discharge shots and particulates number has a waved radial distribution with 0.5mm-wide deposition zone. Based on these quantitative results, the risk of reignition and field-distortion failure that are triggered by particulates can be assessed.

1. Introduction

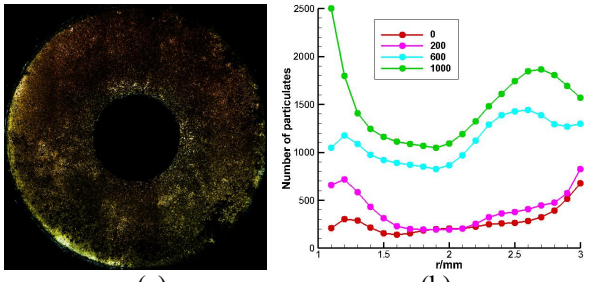
Particulates is generated from electrode erosion inevitably, when electrode surface is bombarded by ~kA current. These splashing particulates could lead to local field enhancement and degradation of reliability, and even gap failure [1-2], which acts as a key restrictive factor in pulsed power field.

Insepov and Norem [3] indicate that particulates are produced when the plasma pressure splatters liquid droplets away from the molten surface. Traditionally, these eroded features are addressed by empirical methods (SEM etc.) and their horizontal size r could be gained [4]. However, as reported by [5], the field enhancement factor β is function of h/r and information of height h is rarely reported.

This paper performs a statistical analysis of particulates' height and obtains their quantitative distribution from electrode erosion of gas spark gap.

2. Analysis results

Experimental details are described in [6]. Fig. 1(a) gives confocal image of cathode surface after 1000 shots, which is densely covered with particles. Based on statistical analysis, radial distribution of particles number is obtained in Fig. 1(b), which would contribute to tracing where and how the interaction between arc and electrodes occurs.



(a) (b)

Fig. 1 (a) electrode surface after 1000 shots; (b) radial distribution of particulates number

Dense particulates on the electrode surface are layered according to their height range with statistical method in [6]. Spatial distribution of particulates are reconstructed and shown in Fig. 2. Particulates are concentrated at the inner edge and 0.5mm-wide deposition zone at r=[2.35, 2.85]mm. These results would throw new light into design of gap reliability.

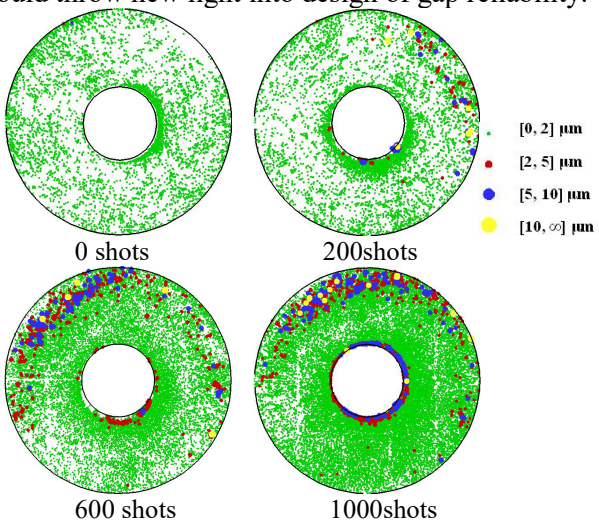


Fig. 2 Reconstructed distribution of particulates

3. References

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