# CONTROL OF VACUUM ARC MACROPARTICLES BY NEGATIVE REPETITIVELY PULSED BIASING

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The results of an experimental study of the influence of a substrate negative bias with various pulse widths and pulse repetition rates ranging from several pulse per second (p.p.s.) to $10^5$ p.p.s. on the macroparticle (MP) accumulation on substrate immersed in a DC titanium vacuum arc plasma are presented. It was found that the rate of MP deposition on the substrate surface depends significantly on the bias pulse parameters and the processing time.

The experimental data of the MP amount on the steel sample versus pulse frequency are presented in Figure 1. Increasing the bias pulse frequency from 10 to $10^4$ p.p.s. led to a gradual reduction in the MP number acquisition on the target. However, this decrease did not exceed 20%. The character of the curve varies considerably in the bias-pulse frequency range of $10^4$ to $10^5$ p.p.s.. In this frequency range of the bias pulses, the surface MP number density decreased 5-fold.

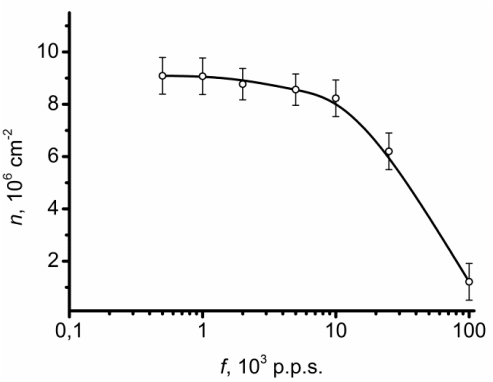


*Figure 1. MP number density (n) versus pulse repetition rate (f) at φb = –2 kV, a processing time of 30 s, and a cathode– steel substrate distance of 23 cm.*

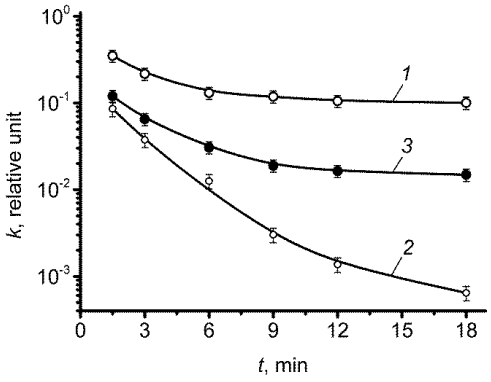


*Figure 2. Reduction in the MP number acquisition on the target versus treatment time (t): 1 – droplets diameter D > 1.5 μm, 2 – droplets diameter D < 1.5 μm, and 3 – all MPs.*

Figure 2 demonstrates the various trends in MP behavior for MP diameters smaller and larger than 1.5 μm. For MPs of more than 1.5 μm in diameter, some stabilization (Figure 2, curve 1) occurs such that for sufficiently long processing times, the large size MP amount is independent of the sample treatment time. Ultimately, a tenfold decrease in the MP surface density is reached for large MPs of more than 1.5 μm in diameter. For MPs of less than 1.5 μm in diameter, there is a rapid reduction in the relative surface MP number density with increasing processing time (Figure 2, curve 2). For a processing time of 18 min, the surface number density for MPs of less than 1.5 μm in diameter decreased 1500-fold. In fact, only individual MPs were observed on the surface after long time processing. Curve 3 in Figure 2 indicates that for processing times of more than ~10 min a 67-fold reduction of droplets total number density has been achieved.

The influence of the multiple recharging of MPs in the plasma and the sheath on the reflection of these MPs in a sheath electric field is discussed.