Abstract Submitted
for the GEC20 Meeting of
The American Physical Society

An Analytic Expression for Cluster Mean Diameter and Dispersion After Nucleation Burst MIKAEL TACU, CEA de Bruyeres-le-Chatel, ALEXANDER KHRABRY, IGOR KAGANOVICH, Princeton plasma physics laboratory — We propose a new method of estimating the mean diameter and dispersion of clusters of particles, formed in a cooling gas, after the nucleation stage. The gas could be for example created by plasma arc or dielectric barrier discharge. The cluster formation is described by Friedlander's model [S.K. Friedlander, Ann. N.Y. Acad. Sci. 354 (1983)]. In the case of an uniform growth of supercritical particles, Friedlander's model can be simplified and if the cooling rate is typically smaller than $10^6 K/s$, primary constituents consumption by nucleation can be neglected with respect to their deposition on clusters. The nucleation rate can then be approximated by an exponential function. Using this approximation we derive analytical formulas for both mean diameter and its dispersion after the nucleation stage, as a function of cooling time and collision time between gas particles. These formulas can be used to predict diameter and dispersion variation with the initial particle concentration and cooling rate. It is also possible to use them as an input to the coagulation stage, without the need to compute complex cluster generation during the nucleation burst. We compared our results with a nodal code (NGDE) and got excellent agreement.

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Date submitted: 09 Jun 2020 Electronic form version 1.4