posed based on C_2 insertion into dimer rows of the reconstructed (100) surface. It turns out that the C_2 particle density is $\sim 10^8$ cm^{-3} even in CH_4-1%H_2-99% mixtures, so that C_2 could in principle serve as an embryonic nucleus in H_2-rich plasmas as well. However secondary nucleation in such mixtures is likely to be impeded by the fact that C_2 does not lead to nucleation on hydrogen-terminated (100) surfaces, as elucidated by ongoing theoretical calculations. In contrast the much higher nucleation rates of 10^{10} cm^{-2} s^{-1} accompanying nanocrystalline diamond growth in CH_4-1%Ar-99% mixtures are due to the increase in C_2 particle densities from 10^8 to 10^{12} cm^{-3} and the likelihood that in such plasmas the diamond surface is largely not terminated by hydrogen. The embryonic C_2 nuclei are no longer regasified efficiently by the low concentrations of atomic hydrogen present in the plasma and grow to critical size so as to form new diamond crystallites. The reduction in growth rate by a factor of five that accompanies the transition from micron- to nanometer-sized crystallites may be due in part to the activation energy associated with forming a nucleus of critical size.

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