Parametric study of methane dissociation and deposition rates in a Ar/CH_4 RF plasma

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As with many other hydrocarbon precursors nanoparticles can be formed in low temperature plasmas from methane. It has been documented, compared to some other gases, that relatively high power densities are required [1]. Here a systematic study concerning the ideal nanoparticle formation conditions for a Ar/CH_4 mixture in a RF plasma is presented. In general, the same dependence on the discharge power is found. However, under low pressure and low methane flow nanoparticles can also be formed at relatively low power. Furthermore, the overall methane dissociation rate is measured by means of mass spectrometry. A simple model is fitted to the evolution of the methane concentration after plasma ignition for varying discharge power, pressure and methane gas flow (figure 1). A connection can be made to the film growth rates measured additionally by quartz crystal microbalance.

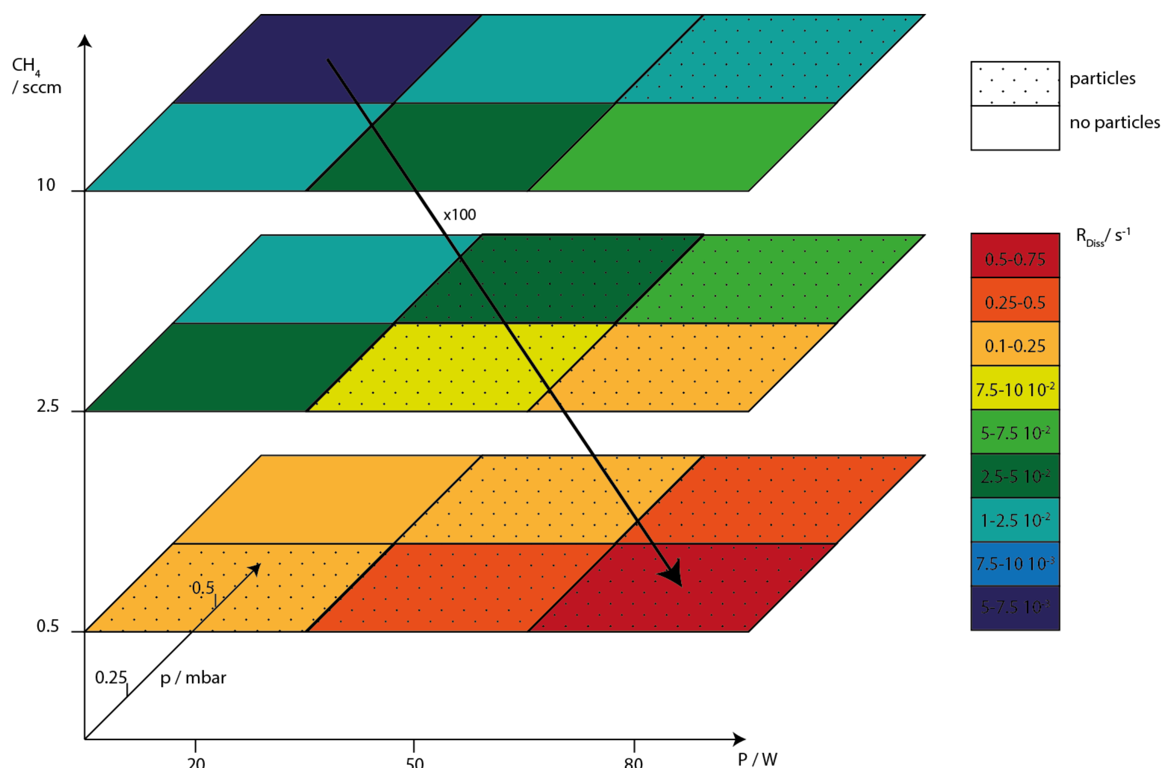

Figure 1: Total methane dissociation rates for varying pressure, methane flow and power; Nanoparticle formation was observed for the dotted parameter regions.

References

[1] J. Berndt et al., Dust particle formation in low pressure Ar/CH_4 andAr/C_2H_2 discharges used for thin film deposition, Vacuum **71**, 377–39 (2003)

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