Dust particle formation in argon-acetylene plasmas and interaction with (extreme) ultraviolet radiation

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Dust particle formation in argon-acetylene plasmas and interaction with (extreme) ultraviolet radiation

F.M.J.H. van de Wetering, S. Nijdam, G.M.W. Kroesen
Eindhoven University of Technology, Department of Applied Physics, P.O. Box 513, 5600 MB Eindhoven, The Netherlands

In extreme ultraviolet (EUV) lithography, ionic and particulate debris coming from the plasma source plays an important role. We started up a project looking more fundamentally at particulate formation in plasmas and the interaction with EUV radiation. To this end, we study a capacitively-coupled radio-frequency (13.56 MHz) argon-acetylene plasma.

In low-pressure hydrocarbon plasmas dust particles spontaneously form under certain conditions. The whole process occurs in a matter of seconds to minutes after igniting the plasma and results in a cloud of particulates up to micrometer sizes levitating in the plasma.

Our aluminum cylindrical discharge chamber also serves as a resonant cavity for low-power microwave (2 – 8 GHz) signals. The frequency at which resonance occurs is a measure for the free-electron density of the plasma.

We present preliminary results on the temporal evolution of the electron density during dust particle formation up to several minutes after plasma ignition. Furthermore, we present an overview of approaches for future research predominantly aimed at the interactions in a more EUV-like environment.