Energy flows in plasma-assisted sputter deposition in connection with film properties

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Abstract.

An important scientific and technological challenge for the coming decades will be the understanding of the interaction between a plasma and a solid surface. This problem appears in many fields of physics, and turns out to be relevant in plasma-assisted sputter thin film deposition. Here, the interactions plasma/cathode and plasma/film are essential in order to understand the properties of the film. This effect is even more important when growing materials whose solid structure is meta-stable. SiO_x $(0 \le x \le 2)$ thin films are typical examples of meta-stable structures: they tend to form separate nano-domains of SiO_2 and $a-Si$, whose size and spatial distribution depend on the energy given to the film during the deposition. Two fundamental processes are believed to be relevant as energy sources in typical deposition conditions: ion bombardment and heat flows from the neutral gas. In this talk, we present the current state of the research at the Debye Institute (Utrecht University): a theory to explain the properties of the ion bombardment on the cathode, based on recently found scaling laws in the plasma sheath and pre-sheath, and the heat transport problem in the plasma. Experimental data will also be presented showing the validity of these theories. Using these results we believe we can correlate the thin film nano-structure and the plasma properties accurately in the near future.