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ADVANTAGES OF ENERGY INFLUX MEASUREMENTS IN LOW PRESSURE PLASMA PROCESSES

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The energy transferred in plasma/surface interaction plays a major role in low pressure plasma processing of materials (deposition, etching, surface treatment...). In most works the energy influxes are determined from the surface temperature evolution with systems called calorimetric probes, in which detection of transient transfers (recording time of several minutes) is impossible and separation of the contributions very difficult.
We have designed a diagnostic for direct and real time measurements, by using a sensitive commercial Heat Flux Microsensor (HFM) composed of a thermopile. This diagnostic was successfully used in silicon etching process to determine the energy released by a chemical reaction onto a surface, and in thin film plasma sputtering deposition to detect the low energy contribution of the condensing atoms (mW/cm^2 to 10ths of mW/cm^2). In recent works this diagnostic was used in magnetron sputtering processes in various regimes (DC, pulsed-DC and HiPIMS) and for different magnetic field configurations (balanced and unbalanced). Energy deposited by fast collisional processes was found very high in the UB-HiPIMS case, whereas in B-HiPIMS heating of the target was evidenced, leading to a thermally assisted deposition process. In reactive sputtering deposition of oxides, these measurements allow to evidence several mechanisms of energy transfer at the substrate such as oxidation of the growing film or interaction with energetic particles originating from the sputtering discharge.
In the present contribution examples of energy influx measurements in various low pressure plasma processes will be presented.

Keywords
plasma/surface interaction
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