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Dynamic Measurements of Secondary Electron Emission Coefficient during PIII Processing

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Plasma based deposition processes are commonly used in industry to guarantee high quality coatings with versatile properties. Modern technologies including magnetron sputtering and HiPIMS crucially depend on the plasma and electrode parameters. For example, secondary electron emission due to impinging ions is an essential intermediate step in these PVD processes. At the same time, secondary electrons are an ubiquitous nuisance in plasma immersion ion implantation (PIII) since they increase the primary current for the pulse generator by nearly one order of magnitude for voltages higher than 10 kV. Nevertheless, it is still feasible to measure secondary electron yields for arbitrary materials in the energy range between 0.5 and 5.0 keV. Using a passive thermal probe, the emission of secondary electrons can be detected with reasonable time resolution, which allows detailed in-situ measurements of the surface state (i.e. metallic, oxidised or nitrided) and its time evolution during either sputtering of surface layers or growth of compounds by ion implantation. Thus, a dedicated investigation of the relative secondary electron emission of materials is possible. In this presentation, the time evolution of the secondary electron emission is presented as a function of ion energy using argon ions for selected metals including Al, Mg, Ag and Ti to elucidate the nature of the native oxide layer.
Using ion implantation with very short pulses and surface neutralisation by electrons between these pulses, even non-conductive materials can be investigated. For a proof of principle, the secondary electron emission of polymers is investigated to establish whether prolonged storage in air leads to differences in the secondary electron yield.

Keywords
secondary electron emission
passive thermal probe