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High rate PECVD of a-C:H coatings in a hollow cathode arc plasma

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Hard amorphous carbon films deposited by plasma-based processes have increasing importance for tribological applications, e.g. as protective coatings on components or in order to reduce their friction. However, most plasma-activated CVD and PVD techniques suffer from their poor deposition rate and low economic efficiency. At FEP, a hollow cathode-based plasma source has been established as a versatile, reliable, and highly efficient tool for plasma pretreatment, plasma-enhanced PVD processes, and reactive gas activation in large volumes. As a further application field, this plasma source is being used for PECVD of amorphous hydrogenated carbon films (a-C:H). Acetylene has been introduced into the hollow cathode plasma as a precursor. The plasma composition has been characterized by an energy-resolved ion mass spectrometer. Intense ionization, dissociation, and polymerization effects have been measured, which were strongly increased by the reduction of argon gas flow rate through the hollow cathode tube. Moreover, the ion energy distributions showed high energy tails up to 100 eV in dependence of the spatial distribution of ion generation.
A-C:H films have been deposited on stainless steel and silicon substrates with growth rates up to 1000 nm/min. Nanoindentation measurement of the a-C:H coatings revealed hardness up to 18.5 GPa. In this paper, film properties and compositions will be discussed and related to the corresponding plasma conditions obtained by energy-resolved ion mass spectrometry.

Keywords
hollow cathode arc
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