

Molecular spectroscopy study of a supersonically expanding arc plasma

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MOLECULAR SPECTROSCOPY STUDY OF A SUPERSONICALLY EXPANDING ARC PLASMA

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A supersonically expanding argon/hydrogen plasma jet is used as a medium to dissociate and ionize hydrocarbons to produce carbon films, ranging from crystalline (graphite, diamond) to amorphous films (a-C:H) and polymers, with high growth rates up to $1 \mu\text{m/s}$. These films can be produced by varying parameters like gas flow rates, gas types, arc power, vessel pressure and substrate temperature. A simple relation is found between the external parameters and the film parameters like crystallinity, refractive index, band gap and hardness. To relate the internal plasma parameters like ionization degree, ion densities/fluxes, radical densities/fluxes and temperatures, emission and absorption spectroscopy is carried out. Rotational and vibrational temperatures are calculated by fitting measurements of the $A^2\Delta-X^2\Pi$ and $B^2\Sigma^-X^2\Pi$ emission bands of CH. Its important to note that in the simulation of the spectra besides the radiative loss also predissociation of the first and second vibrational level are taken into account. In absorption C_2 , CH, CH^+ , CH_2 , and CH_3 radical densities/fluxes as a function of parameter settings and position in the jet are measured.