Gas phase FT-IR absorption spectroscopy as a quantitative diagnostic method for cold plasmas - Application to hollow cathode discharges of acetylene and sulfur reduced compounds (DMS and DMDS)

Abstract: Gas phase compounds produced in low pressure dc hollow cathode flowing discharges of acetylene, dimethyl sulfide (DMS) and dimethyldisulfide (DMDS) have been, by the first time, identified and quantitatively measured through in situ FT-IR absorption spectroscopy. Experimental discharge parameters have been varied in the ranges where stable enough plasmas were produced. A high conversion of precursors to non-volatile compounds is observed. Only diacetylene has been detected in the infrared spectra of acetylene/inert gas discharges, with yields between 3 and 13%. Its appearance indicates that the C2H radical is the main intermediate species produced in such discharges. CS2, CH4 and C2H2 have been the most abundant products detected in the infrared spectra of DMS and DMDS plasmas, their maximal yields being in the range 5-20%. The concurrent production of CO, CO2 and OCS, with yields one to two orders of magnitude lower, must be attributed to oxidation processes of the precursors due to air traces in the discharge cell. No final gaseous compounds, either oxygenated or not, suggesting the production of the CH3S radical as intermediate species were detected in these plasmas. The results presented clearly prove that hollow cathode discharges (HCD) produce cold plasmas where high temperature chemistry is conducted.