Drastic effects of N_2 addition in the ion composition of C_2H_2 glow discharges

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From the ~300 molecular species identified until now in the interstellar media (ISM), compounds including C and H dominate, a lot of them of aromatic character, being C_2H_2 one of the most abundant. Glow discharges containing C_2H_2 are efficient laboratory systems to generate and study many of the neutrals and charged species of interest in astrophysics. They can be also good factories of carbonaceous deposits, of major interest for industrial applications and that can resemble the interstellar dust.[1] Moreover, many of the species found in the ISM contain heteroatoms, more specifically, C-N chemical bonds,[2] which are of prime importance in prebiotic chemistry. The ionosphere of Titan, Saturn's satellite, is also rich in these compounds.[3]

Plasmas of C_2H_2+Ar+N_2 generated in capacitively coupled RF discharges are used in this work to study and identify the neutral species and ions of both signs produced in conditions of incipient polymerization, previous to particle formation. The study shows that N_2 addition to the C_2H_2+Ar plasma, even in very small proportions, produces a drastic effect in both the diversity and the concentration of the different species, leading to a high enrichment and complexity in the plasma composition.

Particularly interesting is the global loss of cations and gain of anions with the increase of N_2 and the contrasting behaviour of charged species with or without nitrogen. At present, the anions detected in interstellar space belong to the $C_{2n}H^-$ and $C_{2n-1}N^-$ ($n \leq 5$) families, and it is worth noting that the interstellar anion distributions[4] are very similar to those found in the laboratory discharges with small N_2 proportions.

This study can additionally shed some light on the basic processes in the anion chemistry that takes place during the first stages of polymerization in acetylene plasmas devoted to dust generation, as well as in astrochemical models, which nowadays present some controversies.

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