Development of a Carbon Cluster Ion Source with a Hollow Cathode

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Abstract
The carbon cluster ion source were utilizing a monoplasmatoron ion source with a cold carbon hollow cathode. Changing the gas injection position of the hollow cathode caused the difference in the ease of transition to hollow cathode glow from glow discharge. At about 36 Pa estimated Ar gas pressure in the ion source, 70 mA discharge current, 1 kV extraction voltage, it is found that the branched gas flow hollow cathode produced 120% of C+, 182% of C2+, 200% of C3+ and 192% of C4+ compared with the branched gas flow hollow cathode.

The carbon ions beam characteristics (Ar gas)

Condition
Carrier gas : Ar
Gas pressure : 36 Pa
Discharge Current : 30 mA
Voltage : 0.48 kV
Lens voltage : 0.77 kV
Extraction voltage : 1 kV

The peak of C-C4 spectrum is analyzed by deference discharge conditions

The carbon ions beam characteristics (Ar + CH4 mixture gas)

Condition
Carrier gas : Ar + CH4
Gas pressure : 36 Pa
Lens voltage : 0.77 kV
Extraction voltage : 1 kV

The carbon ions beam characteristics (Ar + CH4)

The branched gas flow hollow cathode produced C4+ of 152%, C2+ of 242%, C3+ of 145% and C2+ of 230% compared with the straight gas flow hollow cathode at 36 Pa Ar gas pressure, 70 mA discharge current and 1 kV extraction voltage.

Summary

The discharge characteristics
➢ The two discharge characteristics of the straight and the branched gas flow hollow cathode had glow discharge region before a discharge voltage drop, hollow cathode glow region by a discharge voltage drop and transition region from glow discharge to hollow cathode glow.

The branched gas flow hollow cathode produced C+ of 120%, C2+ of 182%, C3+ of 200% and C4+ of 192% compared with the straight gas flow hollow cathode at 36 Pa Ar gas pressure, 70 mA discharge current and 1 kV extraction voltage.

The branched gas flow hollow cathode produced C4+ of 152%, C2+ of 242%, C3+ of 145% and C2+ of 230% compared with the straight gas flow hollow cathode at 46 Pa gas pressure (Ar : 98%, CH4 : 2%), 30 mA discharge current and 1 kV extraction voltage.