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## Development of a Carbon Cluster Ion Source with a Hollow Cathode

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Shallow carbon implantation by low energy carbon cluster ions can be an effective method to reduce heavy metal contamination of Si wafer for semiconductor industry. An ion source utilizing high voltage hollow cathode discharge is designed and being tested in order to examine the capability to generate carbon cluster ions. A 35.5 mm inner diameter, 40 mm long glass made ion source has a carbon hollow cathode electrode, a carbon anode electrode and an electrically floated carbon intermediate electrode. The hollow cathode has a 22 mm inner diameter, 30 mm outer diameter and 30 mm height. The composition of the extracted beam is analyzed with a magnetic deflection type mass analyzer of 285 mm Larmor radius. The ions travel about 800 mm to reach the entrance to come into the field region of the mass analyzer, change the direction by 90 degree and further travel another 800 mm distance to reach the Faraday cup. Typical mass spectrum taken at about 40 Pa estimated Ar gas pressure in the ion source, 8 mA discharge current, 485 V discharge voltage and 4 kV extraction voltage shows that carbon clusters are generated with the ratios: 0.012  $[C^+/Ar^+]$ , 0.071  $[C_2^+/Ar^+]$ , 0.55  $[C_3^+/Ar^+]$ , 0.00091  $[C_4^+/Ar^+]$ , 0.00055  $[C_5^+/Ar^+]$  0.0016  $[C_6^+/Ar^+]$ , and 0.0053  $[C_7^+/Ar^+]$ . Carbon cluster ion production is being investigated for different discharge conditions.

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