

## Discharge characteristics in liquid helium, liquid nitrogen and pure water preparatory to fabrication of carbon nanomaterials

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Arc discharge in liquid helium is a promising method for fabricating high-quality carbon nanomaterials. We have been reported that, at low temperature, liquid carbon atoms emitted by discharge cool quickly and start to combine with some amount of energy, enabling creation of carbon nanomaterials with basic structures. Our subsequent work has focused on CNT fabrication in liquid helium, with the goals of achieving both high reproducibility and a better understanding of the details of fabrication that will enable us eventually to fabricate nanomaterials with new characteristics. Herein, we investigate the conditions for fabrication of carbon nanomaterials by arc discharge in low-temperature liquid such as liquid helium by studying the discharge characteristics in liquid helium and the obtained emission spectra of the discharges. Measurements of the discharge characteristics of the resulting plasma and observation of the associated optical emission spectra show that the behaviour of discharge current over time and the associated spectra depend strongly on discharge voltage and both may be related to the temperature of the carbon target. However, changes in discharge voltage and current with time are almost the same regardless of whether the liquid is pure water, liquid nitrogen or liquid helium. Emission spectra from the discharge show a strong dependence on discharge voltage.