Formalism to Study the Effect of Hydrogen on the Plasma-Assisted Growth and Field Emission Properties of the Graphene Sheet

N. Gupta¹, S. C. Sharma¹, and R. Gupta¹

¹Department of Applied Physics, Delhi Technological University (DTU), Shahbad Daulatpur, Bawana Road, Delhi-110042, India.

The catalytic growth of graphene grown via plasma enhanced chemical vapour deposition depends significantly on hydrogen in the feed gas. The effect of hydrogen on the dimensions of graphene has been investigated through a theoretical model that incorporates the charging rate of the graphene sheet; number density of all the plasma species, i.e., electrons, positively charged ions, and neutral atoms; and the growth rate of the graphene sheet. The numerical calculations have been carried out for typically glow discharge parameters and it is found that the thickness and height of the graphene sheet decreases with increase of the hydrogen gas density. Using the results obtained, the effect of hydrogen on the field emission properties of the graphene sheet has been proposed. It is found that the field enhancement factor $\beta$ increases with the increase of hydrogen gas density. Some of the results of the present investigation are in accordance with the existing experimental observations. The results of the present model can serve as a major tool in analyzing the field emission characteristics of the graphene sheet.