Graphene is a hybridized carbon sheet with a honeycomb structure and has drawn much attention for its extraordinary characteristics such as a high mechanical strength and electrical conductivity. However for the purpose of this thesis, the plasma enhanced chemical vapor deposition PECVD method for producing graphitic carbon is explored further. The purpose of this research is to model and simulate the PECVD of graphitic carbon from methane gas using a plasma spray torch. In addition, the interaction of various plasma torch parameters such as spray height, gas flow rate, and electron density among other variables are explored to find their effects on the entire spray process. A Finite Element Method was used to model this setup and was implemented using COMSOL; which is a commercially available FEM modeling software. This model was setup to consist of four coupled physics: gas flow; electrostatics, drift diffusion of electrons in the plasma, and the transport to and deposition of graphene on the substrate. Experimental reaction rates and cross-sectional collision data for the simulation was taken from published literature. The results show that deposition height varies inversely proportional to the deposited carbon film height and growth rate. Furthermore, the simulations were then used to predict qualitatively, the concentrations of reactive species as well as the influence of methane gas-flow velocity and total gas pressure on the deposition rate of graphitic carbon. The main significance of this research is to show that plasma characterization and modeling are valuable tools in plasma spray design and optimization.