On the relationship between microwave plasma flow instability and functional properties of gas phase synthesized graphene nanosheets

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Abstract

Synthesis of graphene with controlled properties such as defect density and chemical doping can be of advantage in wide range of practical applications. In this work we show close relationship between atmospheric pressure microwave plasma instability during graphene nanosheets synthesis by decomposition of ethanol and its functional properties i.e. electrical sheet resistance and high temperature oxidation reactivity. During the synthesis process chemical kinetics and nucleation of graphene depends on the argon gas temperature and optimal formation of growth species in the gas phase [1]. Recently, we have showed [2] that plasma instability caused by high velocity gas flow and plasma discharge movement, caused by combination of central Qc and secondary Qs gas flow rate in our dual-channel nozzle configuration, led to increased amount of structural disorder as well as increased amount of carbon-oxygen functional groups and sp^3 phase content in the grown graphene nanosheets (**Figure 1**). These physical and chemical changes were reflected in the change of electrical conductivity and thermal stability of graphene nanosheets layer deposited on the SiO_2 substrate Further change of ethanol precursor flow rate with increase of microwave power and the substrate temperature led to the transition from horizontal to vertical growth of few-layer graphene layer [3]. Prepared nanomaterial was analyzed by SEM, TEM, Raman and X-ray photoelectron spectroscopy. Information about plasma processes was obtained by optical emission spectroscopy, high speed and ICCD camera imaging.
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FIGURES

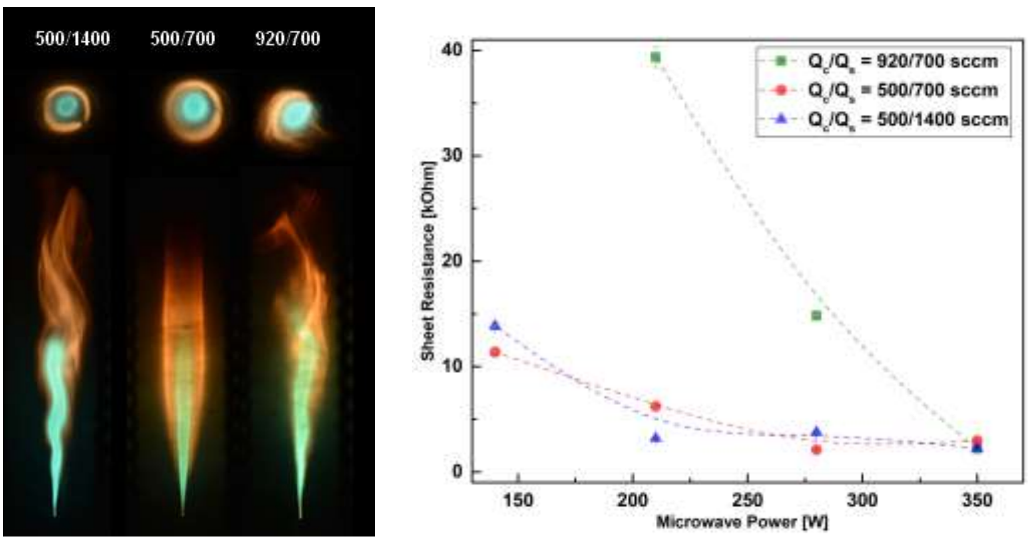

Figure 1: Microwave plasma instability dependence on Qc/Qs flow rate on the left and the change of graphene nanosheets layer sheet resistance on the right.