Raman study on the effects of annealing atmosphere on graphene

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Abstract

Despite extensive research on graphene [1], there are still lacks of understanding on the structural changes under harsh stress environments such as high current in uncontrolled atmosphere. The investigation of the structural changes of graphene patterned into devices at high temperature would be important as the electrical current path of graphene becomes narrower and thus stronger in heat dissipation. Here, we performed a comparative study of the structural and electronical changes of graphene for as-prepared graphene and patterned graphene in a micro-bridge heated up to 500 °C in air or Ar. While the as-prepared graphene heated in air or Ar was nearly free from the structural changes, the micro-bridge graphene exhibited strong structural changes after heating in Ar, i.e. the amorphous-like broad peaks remained even after cooling back to room temperature. On the other hand, the micro-bridge graphene heated in air was observed to release stress probably due to formation of vacancies by oxygen adsorption. The different behavior of micro-bridge graphene heated in Ar from that of large-area graphene in the same condition is striking. This means that graphene in microscopic devices should be treated differently from the graphene of large area [2-3].

References

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[3] J.Son, M.Choi, H.Choi, S.J.Kim, S.Kim, K.Lee, S.Vantasin, I. Tanabe, J.Cha, Y.Ozaki, B.H.Hong, I.Yang, J.Hong, Carbon, 99 (2016) 466

Figures

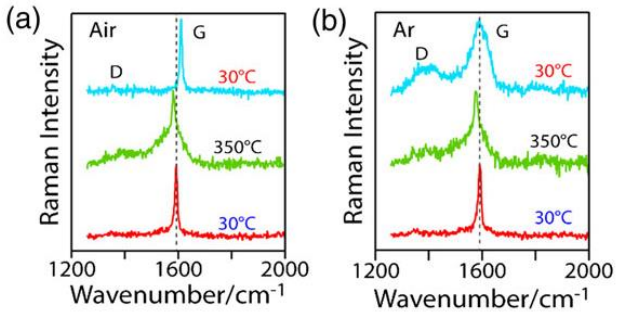

Figure 1: The changes of Raman spectra of the micro-bridge graphene in different atmosphere. Figures (a) and (b) show the changes in peak wavenumber and shape of the G-peak of the micro-bridge graphene samples heated in air and Ar, respectively; before heating (bottom spectra), during heating (middle spectra), and after cooling (top spectra).

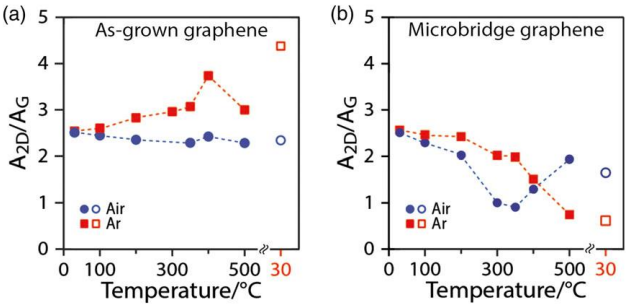

Figure 2: The ratio of the intensity of 2D-peak to that of G-peak (I_{2D}/I_G) in the Raman spectra of the large-area graphene (a) and the micro-bridge graphene (b) samples during heating and cooling back to room temperature