Reduction of metal-graphene contact resistance by direct growth of graphene over metal

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Abstract

Graphene is a zero-band gap semiconductor and has emerged as a promising candidate for device application due to its superior electrical performance [1, 2]. Despite of the electrical potential of graphene, the contact resistance between metal and graphene can be a major limiting factor of device performance. So understanding the metal-graphene contact is great scientific and technological importance. However, despite its importance, there have been few reports about understanding the dominant factors that control the contact resistance between graphene and metal. The detailed properties and method to improve the contact with graphene and metal have not yet been explored. Here we demonstrate a new method to reduce the contact resistance between transferred graphene and metal using CVD grown graphene as a buffer layer. Graphene has direct contact with electrode metal in a conventional contact, but in our method, there is another synthesized graphene layer between metal and graphene, and it can reduce the contact resistance between them. Metal-graphene contact resistance has been widely measured by the transfer length methods (TLM)[3-5] or through a graphene field effect transistor (FET). Using both approaches, we measured the total resistance between electrodes in a TLM pattern or in a graphene FET and extracted the contact resistance.

The contact resistance of proposed structure is nearly half of conventional structure. Moreover, CVD growth graphene has more similar resistivity with Cu and higher adhesion energy than transferred graphene on Cu. The results indicate that the CVD growth graphene is hardly contact with Cu comparing with transferred graphene, which can make the charge transfer between electrode and channel in device easily.

References

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Figures

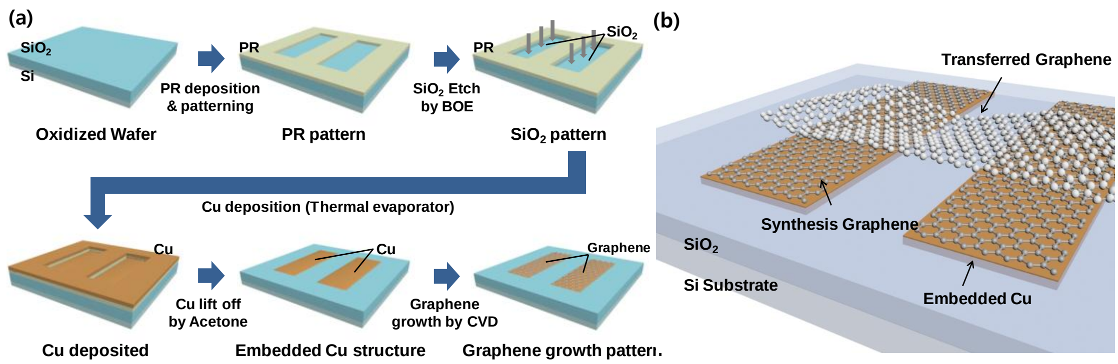

Figure 1. (a) Fabrication process of embedded Cu substrate for chemical vapor deposition (CVD) graphene growth. (b) The improvement of metal-graphene contact structure using CVD growth graphene as buffer layer.

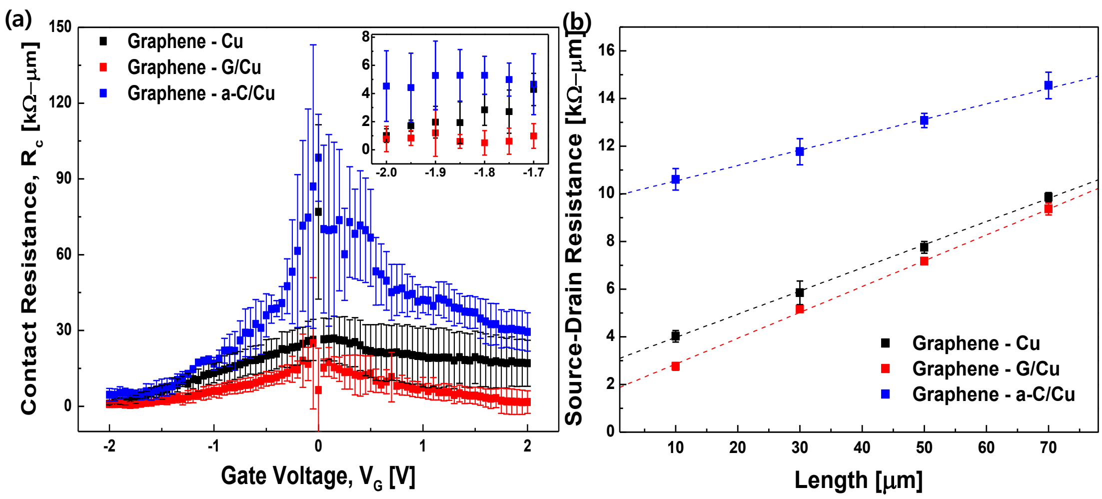

Figure 2. (a) Contact resistance as a function of gate bias, showing the gate bias and contact structure dependence. The inset graph shows contact resistance results at gate biases of -2 V and -1.7 V. (b) Deriving contact resistance using the TLM pattern.