Contact performance enhancement based on isotype junction effects of thickness dependent MoS2 layers

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Abstract

In early 2000s, graphene was shown to have excellent carrier mobility as a zero-gap semiconductor. [1] Since its discovery, various materials in 2D crystalline structures have garnered significant attention because of their unique properties, which can be used in various fields of academics and industry. [2-4] Recently, transition metal dichalcogenides (TMDs) have become a hot topic of interest due to their remarkable electronic performances and their potential to replace silicon-based systems. Single-layer MoS2 may be the most popular material among TMDs showing clear n-type semiconductor characteristics with a direct-energy band gap that is similar in size to silicon and can be used as an active layer in various electronic devices.

In this work, the difference in the work functions of MoS2 nanosheets with different thickness has been observed based on the relative surface potential values measured by a scanning Kelvin probe microscopy technique. From the energy structure change, a layer-dependent MoS2 isotype heterojunction shows small potential barriers and weak current-rectifying effects. However, the small potential barrier at the junction easily becomes negligible with a 2D contact area that is obtained by the polymer-assisted dry transfer technique showing only linear and symmetric current features. Therefore, we can obtain significant enhancement of contact performance by applying a multilayer MoS2 structure between the MoS2 channel and the metal electrode because two small potential barriers are more advantageous than one large Schottky barrier and they allow increment of the effective contact area.

References

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Figures