Electrical Characteristics of Field-Effect Transistors based on Chemically Synthesized Graphene Nanoribbons

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Miniaturization of integrated electronic circuits down to the sub-10-nm regime requires novel semiconductors that combine high structural precision and integrity with superior and well-defined electronic properties and easy processing. Chemically synthesized graphene nanoribbons (GNRs) are ideally suited to fulfill these requirements. In our work, we show for the first time the dispersion of GNRs in aqueous solution, which is an important prerequisite for the integration of GNRs into complex electronic circuits [1]. As-fabricated GNR transistors show excellent charge injection from the metal contacts and large on-state drain currents, but a small current modulation ratio (**Figure 1**). The latter can be explained by the unfavorable transistor geometry or by the unintentional agglomeration of two or more GNRs in the transistor channel. Using quantum-chemical calculations we demonstrate that the band gap of a GNR dimer can be as small as 30% of the band gap of a GNR monomer (**Figure 2**).

References

[1] U. Zschieschang, H. Klauk, I.B. Müller, A.J. Strudwick, T. Hintermann, M.G. Schwab, A. Narita, X. Feng. K. Müllen, and R.T. Weitz, "Electrical Characteristics of Field-Effect Transistors based on Individual Chemically Synthesized Graphene Nanoribbons", Advanced Electronic Materials 1, 1400010 (2015)

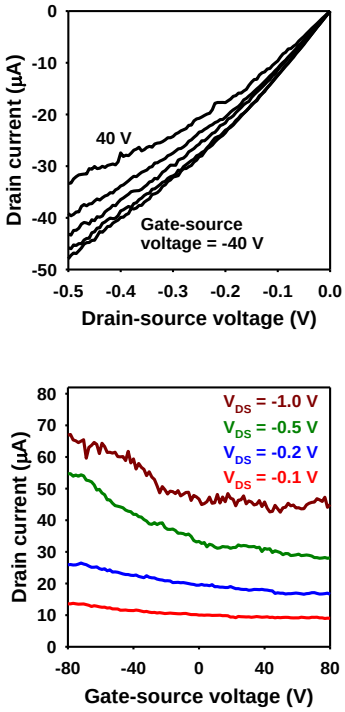

Figure 1: (top) Output and (bottom) transfer characteristics of as-contacted GNR – FET measured under ambient conditions [1].

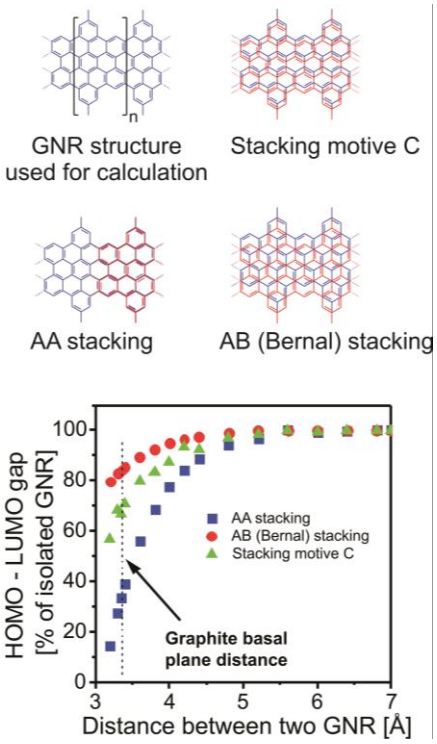

Figure 2: (top) possible stacking motives of GNR (bottom) calculated HOMO-LUMO gap of GNR-dimers in different stacking motives [1].