

A Critical Look at the Molecular Transistor

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Much promise has been placed on the molecular transistor (MT) as a path beyond CMOS for future integration of electronic components, while considerable difficulties remain in implementation of a transistor with useful characteristics. Here we take a look at the MT from the point of view of a transistor designer, with some elementary physics to estimate scaling lengths, screening length, *etc.*, as well as minimum device size consistent with voltage gain and on-off ratio. The problem of space-charge related to current-flow will be examined and shown to be a non-scalable parameter when the current-carrying channel is fully occupied. The impact of the switching mechanism, whether by direct modulation of the energy levels or by conformal change, on the geometric requirements of the electrodes will be assessed. There is an exciting possibility of using molecules to create a "designer multi-element electronic filter", where transmission could be tailored to maximize on-off ratios *etc.* On the other hand, the difficulty of implementing the three-terminal MT raises the question of whether two-terminal logic might not be the better way to go, at least in the short term.