Toward realization of molecular-based devices and circuits

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The utilization of molecular species for logical and memory applications has been suggested since the emergence of the field of molecular electronics. Though important breakthroughs in this field have been demonstrated, the practical use of such devices is still unprecedented.

In this talk I will describe some of recent progress made in our lab aiming for the construction of large-scale molecular-based logic circuits and memory devices.

The devices are based on vertical technology which allows mass production of two- and three terminals devices and circuits (figure 1).

Several types of molecular systems have been investigated using these devices. Of a particular interest are electro-active molecules and proteins which exhibit a strong switching, negative differential resistance and hysteresis properties which makes excellent candidates for future practical molecular devices.

In particular several examples will be addressed:

(i) Multi-peak negative differential resistance device made of Ferrocene Self-assembled monolayer.

(ii) Molecular-quantum dot transistor- a new type of transistor which is mediated by the polaron formation in redox molecules. This type of transistor allows the operation of molecular devices in two distinct modes: gate-controlled switching and gate controlled hysteresis.

(iii) Molecular-based circuits preliminary results.

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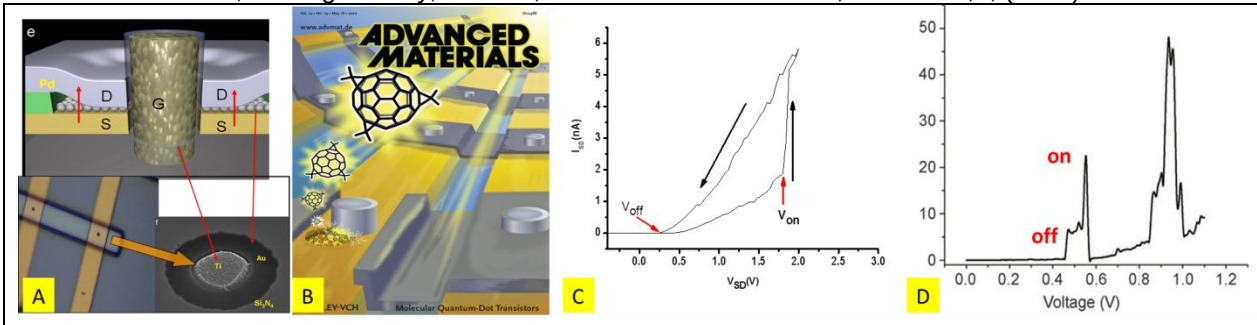

Figure 1 Examples of molecular devices demonstrated in our group and vertical molecular transistor and an artist view of such device comprised of molecular quantum dot (B). C. example of gate controlled hysteresis mode. D. multi-peak NDR molecular device