NANO HIGHLIGHT
Programmable Drug by Electronic Chemical Receptors

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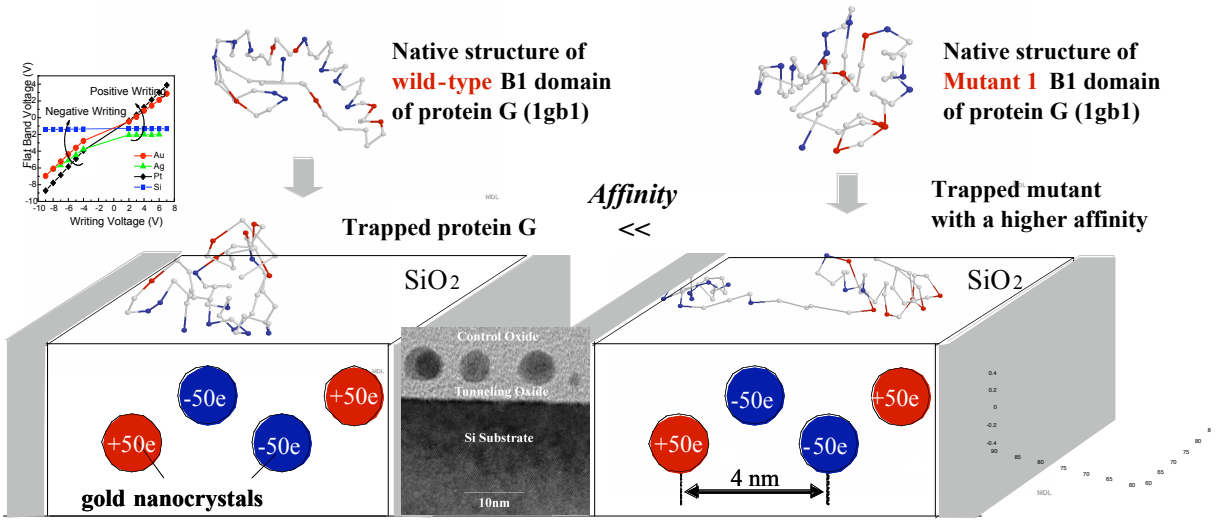
Scientists have been amazed at the molecular selectivity in biological systems for many years, yet the basic operational principles are astonishingly simple: adaptive electrostatic forces from specific redox receptors on a relatively rigid carbon-based backbone. A notable example is the high selectivity between antigens and antibodies. Together with the tremendous progress in pharmaceutical research and computational biology, a huge data base has been created on the underlined molecular information for many biological phenomena. It is intriguing to imagine the possible implementation of a direct electronic interface between this data base and chemical receptors. A Cornell research team has proposed to build such molecular interface with nanoscale resolution by extending the silicon technology underneath the Flash memory, a common data storage device in digital camera and thumb drives. The basic operation of the Flash memory is to control the number of static charges in an electrically isolated structure, namely the floating gate. When the floating gate is scaled to a nanoscale molecule, the charge injection is equivalent to a change in the chemical redox states [2]. The Cornell team has demonstrated, by both experiments and detailed modeling, that such charge density control is realizable and can be applied to protein selection and controlled folding (see an illustration below). Although it is too early to speculate if an electronic antibody can be successfully produced with a programmable, mechanically flexible charge-receptor structure by this approach, the present evidence already shows that we should take a whole new look at how to sense and control individual molecules, maybe sometime in the future, similar to writing a program for robotic control.



References

[1] For further information about this project link to http://people.ece.cornell.edu/kan or email kan@ece.cornell.edu
[2] U. Ganguly, C. Lee and E. C. Kan, "Experimental observation of non-volatile charge injection and molecular redox in fullerenes C60 and C70 in an EEPROM type device", *Material Research Symposium (MRS),* Boston, MA, Nov. 29 – Dec. 3, 2004.