The Bio-Electronic Synapse – Fusing Electronics with Molecular Biology

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Abstract:

Learning a lesson from biology where interfaces and decisions are realized through mutual recognition of two molecules we propose and demonstrate a generic functional interface between electronics and biology. In our bio-electronic synapse one of the recognizing molecules is replaced by an electronic device having two states while for the other molecule we choose an antibody selected in-vitro to discriminate between the two electronic states. Application of 0.6V to the device sets it in the "on" state where the antibody binds the device. A subsequent application of -0.6V to the same device turns it to the "off" state where the antibody detaches from the device.
Using electrochemical Surface Plasmon Resonance (SPR) combined with mutagenesis of the antibody the operation mechanism of the bio-electronic synapse is traced to electronic control over the molecular water structure around the device.
The presentation will conclude with our recent success in implementing the bio-electronic synapse in T-cells taken from the immune system and our current attempts to gain electrical control over their killing activity.

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