Bistable tunneling current through a quantum dot array junction
YIA-CHUNG CHANG, Research Center for Applied Sciences, Academia Sinica, Taiwan and University of Illinois, Urbana-Champaign, DAVID M.T. KUO, National Central University, Taiwan — We investigate the tunneling current through a six-fold degenerate $p$ -like states of a one-dimensional (1D) or two-dimensional (2D) quantum dot (QD) array in the x-y plane. Due to the coupling of $p_x$ and $p_y$ orbitals at neighboring QDs, a 1D or 2D conduction band ($\varepsilon_p$) is formed, whereas the $p_z$ orbitals remain localized due to their weak in-plane coupling. The on-site repulsive Coulomb interaction in the $p_z$ levels ($U$) and that between the $p_z$ level and $p_x/p_y$ level ($U_{dc}$) are taken into account in an extended Anderson model, which is used to investigate the tunneling characteristics of the system. Tunneling current through localized $p_z$ state is calculated in the framework of the Green function technique. Due to the effect of $U_{dc}$, the 1D/2D conduction band states are shifted by a self-energy term $2NU_{dc}$. We find that bistable current can be observed for this system in the Coulomb blockade regime, which makes the system a valid candidate for ultra high-density memory device.