Atomic scale Boolean Logic gates

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At the atomic scale, surface Boolean logic gates can now be designed [1] and experimented [2] from inside a single molecule. They can now be constructed atom by atom using STM vertical single atom manipulations for example on an Si(100)H surface. After discussing why classical and semi-classical atomic scale circuits [3] may not be very practical for beneficiating from the anticipated atom circuits computing power [4], we will present the design rules of the quantum Hamiltonian computing (QHC) approach [5] applied to atom circuits Here, the possibility offered by the QHC approach for a logic function complexity increase is a very good example on how to minimize the interconnection problem that is the number of "classical to quantum" and "quantum to classical" conversions steps required to pass from the atomic scale of an atom circuit to the nanoscale and more in full planar technology. The first practical construction of an atomic scale QHC Boolean logic gate will be presented [6]. A first technological roadmap will also be presented to finally back interconnect and encapsulate such circuits to produced molecular chips for a future planar technology [7].

References

[1] C. Joachim, N. Renaud and M. Hliwa, Adv. Materials, 24, 312 (2012).
[2] W.H. Soe and coll. Phys. Rev. B, 155443 (2011).
[3] H. Kawai, and coll., J. Phys. Cond. Mat., 24, 095011 (2012).
[4] Y. Wada and coll. US Patent n°: 5,561,300, Oct. 1st, 1996.
[5] N. Renaud, M. Hliwa and C. Joachim Phys. Chem. Chem. Phys., 13, 14404 (2011).
[6] M. Kolmer and coll., Nanoscale, submitted (2015).
[7] C.Joachim, Springer Series: "Advances in Atom and Single Molecule Machines" Vol. VII "Nanopackaging", in press (2015).