ABSTRACT

Molecular electronics implies the storage, transmission and processing of information in very large and complex systems of organic molecules.

For any practical realization of molecular electronics, peripheric elements for addressing these molecular systems are absolutely essential, and they represent a similar challenge as molecular electronics itself, and they should be considered part of it. This paper describes the possibility of (i) electrical addressing through ultraminiaturized semiconductor systems of reduced dimensionality, and (ii) optical addressing with microlaser systems and methods of integrated optics.

Semiconductor technology today can reduce dimensions of structures into the nanometer range approaching dimensions of the molecules to be addressed. New quantization effects occur in these extremely small structures. They are specific for low dimensionality, and they will be described in detail. The quantization into subbands, tunneling between subbands in quantum wells, in particular resonant tunneling are interesting features of low dimensional structures. The possibility of an electrical periphery with structures of low dimensionality including new quantum size and tunneling effects is probably very difficult to realize.

Easier seems to be an optical periphery involving microlasers and integrated optics. Attractive, for instance, is the development of tunable microlasers for frequency selective molecular memories. Memories on the basis of photochemical hole burning can potentially reach densities of \(10^{11}\) bits/cm\(^2\), and they require for 'photon gating' the development of such microlasers. A review of the possibility of an optical periphery is given. Recent developments of quantum well lasers, of distributed feedback structures for wavelength multiplexing, and of tunable semiconductor lasers will be presented.

For addressing frequency selective molecular memories, short wavelength semiconductor lasers are desired, and the state of the art in this field is discussed.

Finally, integrated optics as an interesting technology for an optical periphery will be proposed.