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Dynamics of DNA base-pair opening provides a mechanism for sequence recognition

DNA recognition, in nature as well as in man-designed gene targeting, is generally based on thermodynamic equilibrium binding. Since the specificity of interaction is directly related to the binding-site size, thermodynamic recognition by small molecules is necessarily limited. Here we show that an unprecedented selectivity can be attained through "kinetic recognition" by ruthenium(II) complexes that bind to DNA by a threading intercalation mechanism.

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Steps Towards Complex Matter : Information, Self-organization, Adaptation in Chemical Systems

Chemistry has developed from *molecular chemistry*, mastering the combination and recombination of atoms into increasingly complex molecules, to *supramolecular chemistry*, harnessing intermolecular forces for the generation of informed supramolecular systems and processes through the implementation of molecular information carried by electromagnetic interactions.

Supramolecular chemistry is actively exploring systems undergoing *self-organization*, i.e. systems capable of spontaneously generating well-defined functional supramolecular architectures by self-assembly from their components, on the basis of the *molecular information* stored in the covalent framework of the components and read out at the supramolecular level through specific *molecular recognition* interactional algorithms, thus behaving as *programmed chemical systems*.

Supramolecular entities as well as molecules containing reversible bonds are able to undergo a continuous change in constitution by reorganization and exchange of building blocks. This capability defines a *Constitutional Dynamic Chemistry* (CDC) on both the molecular and supramolecular levels. CDC introduces a paradigm shift with respect to constitutionally static chemistry. It takes advantage of dynamic constitutional diversity to allow variation and selection and thus adaptation.

The merging of the features: - information and programmability, - dynamics and reversibility, -constitution and structural diversity, points towards the emergence of *adaptive chemistry*.

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The adapting brain: imaging plasticity in humans

Imaging neuroscience describes the functional organization of human brain at the level of large neuronal groupings, networks and systems. A systems level of description addresses how integrated brain functions are embodied in the physical structure of the brain. Magnetic resonance imaging (MRI) is now the modality of choice in structural and functional imaging neuroscience. The analysis of structural and functional brain images can nowadays be carried out automatically using statistical parametric mapping (SPM). The resultant ability to perform clinical-functional-anatomical correlative studies in life with complete objectivity and unparalleled sensitivity is providing powerful new opportunities for the study of brain pathology and plasticity. One of the most exciting and dramatic observations to come from human brain mapping with a wide range of structural and functional techniques is the dynamic plasticity of function in the brains of patients with strokes. Recent activation studies have provided interesting information about the brain's capacity to adapt with practice and learning and to reorganise after injury. Though presently in the realm of basic physiology, the study of brain plasticity and its modulation by drugs acting on specific neurotransmitter systems and other manipulations indicates novel approaches to learning and to the rehabilitation of stroke damaged adults. Brain maps are dynamic, changing with development, practice, learning, attention, disease progression and in the recovery of function after acute injury. The dynamic plasticity of functional brain maps provides an exciting opportunity to study these processes.

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Nanoporous Capsules/Artificial Cells: From Aesthetics to Multifunctionality

Structurally well-defined soluble metal-oxide based spherical porous nanocapsules/artificial cells interact specifically with their environments as they show:
● adaption behaviour in the sense that their internal clothes are changed according to the specific type of molecules present in their changing environments;
● specific cation uptake and release processes through their pores/channels while their skeletons can be considered as artificial membranes;
● pore closing by complementary guests influencing significantly/specifically encapsulates structures like of water thereby modelling cell response to stimuli.
Further attractive points are: the possibility to perform encapsulation-, sphere-surface-, and multi-supramolecular chemistry at the 20 $\{Mo_9O_9\}$ type pores with crown-ether function, and to use the capsules as nano ion chromatographs. The area shows revolutionary routes to other disciplines, such as materials science in several directions, physics (regarding confined matter properties), and even mathematics concerning the tiling problem of sphere surfaces.

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Attosecond Physics

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Fundamental processes in atoms, molecules, as well as condensed matter are triggered or mediated by the motion of electrons inside or between atoms. Electronic dynamics on atomic length scales tends to unfold within tens to thousands of attoseconds (1 attosecond [as] = 10^{-18} s). Recent breakthroughs in laser science are now opening the door to watching and controlling these hitherto inaccessible microscopic dynamics.

The key to accessing the attosecond time domain is the control of the electric field of (visible) light, which varies its strength and direction within less than a femtosecond (1 femtosecond = 1000 attoseconds). Atoms exposed to a few oscillations cycles of intense laser light are able to emit a single extreme ultraviolet (xuv) burst lasting less than one femtosecond [1,2]. Full control of the evolution of the electromagnetic field in laser pulses comprising a few wave cycles [3] have recently allowed the reproducible generation and measurement of isolated 250-attosecond xuv pulses [4], constituting the shortest reproducible events and fastest measurement to date. These tools have enabled us to visualize the oscillating electric field of visible light with an attosecond "oscilloscope" [5] as well as steering and real-time observation of the motion of electrons in atoms [6] and molecules [7]. Recent experiments [8] hold promise for the development of an attosecond x-ray source, which may pave the way towards 4D electron imaging with sub-atomic resolution in space *and* time.

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