the interaction of nanoparticles with cells and proteins. Such research aims at improved and validated test methods providing reliable data for regulatory risk assessment and is carried out in cooperation with leading laboratories in Europe and worldwide.

In response to the implementation of forthcoming European labelling requirements, the JRC is now developing and validating appropriate methodologies for detection and quantification of nanomaterials in consumer products.

To support laboratories worldwide in assuring the quality of their data, in early 2011 the JRC launched the first European repository of nanomaterials, containing a range of more than 20 different types of nanomaterials which are representative of those from industrial production processes. By making samples available to regulatory authorities, researchers and laboratories, the JRC enables the accurate comparison of data obtained in different test laboratories worldwide. At the same time the JRC launched the world's first certified nanoparticle reference material for size measurement based on industry sourced materials, which should help ensure the comparability of measurements worldwide, thereby facilitating trade, ensuring compliance with legislation.

"Properties that make nanomaterials desirable for certain applications such as drugs – high surface reactivity and the ability to cross biological barriers - are also those that give rise to toxicity concerns"

Researchers and policy makers alike can use the JRC nanohub database, a comprehensive IT platform designed for hosting and managing information on nanomaterials in a harmonised and standardised structure. It is intended to boost interconnections and facilitate synergies between collaborations, and it provides compatibility with the existing European regulatory framework on chemicals.

The JRC's upcoming tasks in the field will include support to the implementation of the newly established definition of nanomaterials in existing regulations, such as REACH, cosmetics legislation or food-related directives, and contributions to the legislation on labelling of products containing nanomaterials. A further challenge is likely to arise in the provision of scientific and technical support to the creation of an inventory of types and various uses of nanomaterials on the EU market as requested by the parliament. ★

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Quantum Computation
Will Molecules Do the Job?

One of the greatest goals in nanoscience is the implementation of quantum information processing (QIP). Quantum computers use the laws of quantum mechanics to realize logic operations, some of which are not accessible by classical technology. They will cause a deep revolution in computation since they will not only reduce dramatically calculation times, but also allow tackling of currently intractable problems.

For a long time, scientists have faced the challenge of finding physical systems capable of encoding the quantum bits of information (*qubits*), and embody quantum gates (QGs), as the components of the processors of quantum computers. A wide variety of systems arising from modern materials physics have shown promise for constituting the technological basis of quantum logics. These include ion traps, photons, nuclear spins, super-conducting circuits or electronic spins. Among them, the latter offer a good definition of a *qubit* (two states defined as |1> and |0>) and exhibit comparatively good quantum dynamic properties.

In addition, electronic spins may be carried by molecules that could be tailored to fulfill the implementation requirements. In this context, exploiting the versatility of chemical design and synthesis for the production of functional molecules as qubits and QGs constitutes an exciting prospect. This bottom-up approach could signify a source of scalable devices since chemical synthesis can furnish an unlimited number of identical molecules. The Grant FuncMolQIP, awarded by the ERC to the *Group of Magnetism and Functional Molecules* (GMMF) from the University of Barcelona, is funding a multidisciplinary project that proposes the use of coordination chemistry for the preparation of molecular devices capable of performing quantum logic operations. It aims to design molecules carrying two electron spin-based qubits in the appropriate disposition to constitute universal QGs. The archetype of such gates is the *controlled-NOT* (CNOT). It inverts the state of one qubit (*target qubit*) if and only if the other (*control qubit*) is in the |1> state. To do this, a molecule needs to possess two *inequivalent* well defined *qubits* and ensure a weak interaction between them.

Recent progress has led to a coordination complex of two dissimilar Tb^{3+} ions that meets all these conditions (Physical Review Letters, 2011, *107*, 117203). Following these promising results, new molecules are being sought with better quantum coherence properties as well as improved operation fidelity; a challenge that will also be addressed through chemical design. The fascinating possibility of using molecules to realize QGs will only follow from a profound collaboration between chemists, physicists and engineers, with a view to solving the problems of addressing these species for readout and write out operations and of integrating them within multi-component devices.

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Representation of a CNOT operation as realized by a [Tb(III)2] molecule by manipulation of its electronic spins. Below is a scheme of this operation in form of rotations of the spins embodying the qubits.