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Ultrafast Data Storage on a Molecular Level

Scientists of the TU Wien achieved a real breakthrough in technological applications of molecular spin-crossover compounds: immobilisation and non-destructive detection of spin states on a real-time scale – the equivalents to 'write' and 'read' of conventional data storage devices.

By solving these existing two major obstacles this technology can now be seen as a potential successor to today's data storage systems, for the design of new generations of magneto-optic memory devices, sensors, etc.

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REFERENCES:
M062/2015, M063/2015

APPLICATIONS:
Data storage technology
Magneto-optical devices
Molecular electronics
Sensoring

DEVELOPMENT STATUS:
Prototype pending

KEYWORDS:
Magneto-optical device
Molecular spin-crossover
Non-destructive read-out
Polarised light

IPR:
EP patent granted

OPTIONS:
R&D co-operation License agreements Patent sale

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BACKGROUND

The spin-transition effect is an electronic phenomenon in which the electron configuration of certain metal ions can assume two different states. The two states differ distinctively in their characteristics, such as magnetic moment, conductivity, electrical resistance, dielectric constant, etc. The change between these spin states can be triggered by external, technologically approved stimuli, e.g. light, temperature, current, strong magnetic fields, pressure, interaction with other molecules, etc.

This technological revolution has been driven by a constant improvement in the understanding on how spins can be switched, manipulated and detected in the solid state.

Manufacture of a technical component necessitates immobilisation of a single molecule layer on a defined surface. However, this had not been achieved successfully until now. Also, the lack of a non-destructive read-out on a comparably fast time scale has been another major obstacle for the design of molecular spin-crossover applications so far.

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In the underlying inventions the developers have succeeded for the first time to produce a monolayer of various spin-crossover compounds on a surface, wherein the switching property is retained (M063/2015). They have also successfully established an easy, reliable and non-destructive, real time method for the read-out of the switching state of the material (M062/2015).

The successful surface application allows to design customised high-performance opto-electronic components in miniaturised form. The particular advantage is that a single molecule is sufficient as a functional unit of the device, and that the switching process can be triggered, e.g. by laser pulses in the femtosecond range.

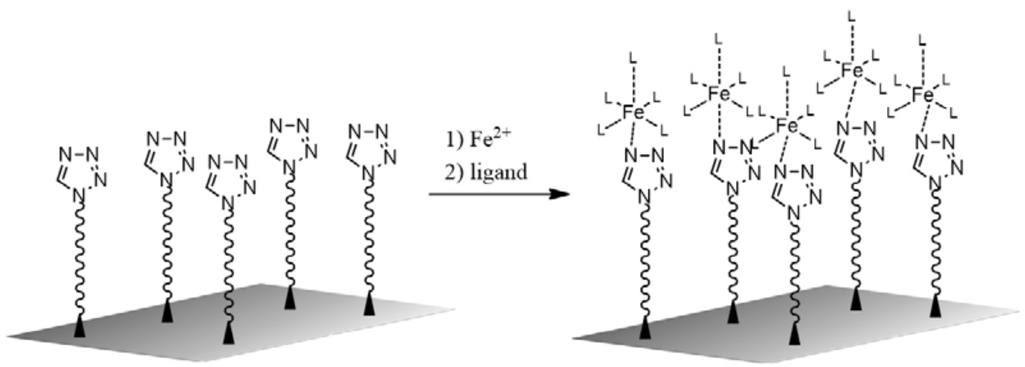

Figure 1: Top-down approach for self-assembly of spin crossover monolayers

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The novel real-time detection method for the switching state allows to design magneto-optic devices based on a defined monomolecular layer of iron spin-crossover complexes e.g. sensors, magneto-optic memory devices, molecular switches, etc.

Thus, extreme miniaturisation and shortest response time can be combined. Such molecular spin-crossover based devices are seen as potential successors to today's hard disc drives.

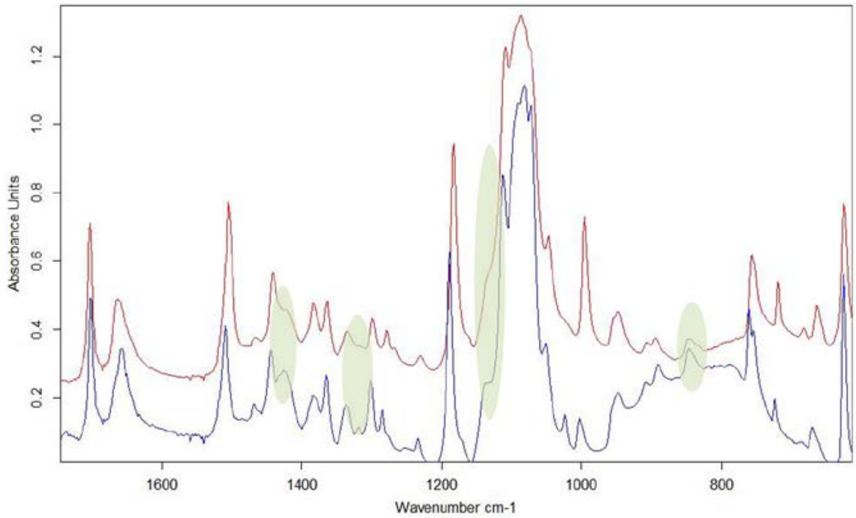

Figure 2: Polarised spectra, highlighting the variation between the two switching states

The cost and power of such miniaturised devices are extremely low, making them highly competitive. Memories built from these devices could ultimately surpass mainstream conventional hard disc drives in density, speed, and cost. Furthermore, molecular spin-crossover compounds can pave the way for radically new device concepts. However, unknotting the full potential of molecules for spin-crossover complexes as monolayers is promising scientific and technological rewards.

ADVANTAGES

- Top-down approach towards switchable monolayers
- Deposition of ionic spin crossover materials
- No limitations regarding design due to surface self-assembly
- Detection of spin state (switching state) in real-time
- Non-destructive read-out concept
- Combination with established technology (polarised light)
- Miniaturisation of electronic devices down to molecular level

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