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Hybrid nanocarbons encapsulating redox and magnetically active nanoswitches

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The electrical coupling of nanocarbons with redox and magnetically active nanoscale objects has attracted a great deal of attention for achieving functional hybrid nanostructures with a wide range of exploitable properties. This is especially important for designing next-generation electronic or spintronic devices that will be based on nanoscale functional materials such as isolated spin centres or single-molecule magnets. In order to harness the magnetic bistability, quantum tunnelling of magnetization, and quantum coherence of nanometer-sized magnetic objects, the coupling to the macroscopic world that is essential for read and write purposes has become a key challenge. Hollow carbon nanostructures with one macroscopic and two nanoscopic dimensions can act as bridges to achieve this coupling, through the encapsulation and confinement of magnetic species, while maintaining their structural integrity and properties that would otherwise induce decoherence (–a major obstacle for quantum applications). Another important challenge facing the humankind today is the production of clean and sustainable energy where electrochemical technologies have shown to play an important role. However, the market potential of electrochemical devices based on electrocatalyst containing precious metals, such as Pt, is currently hindered by their short-term durability. As these precious elements are rapidly diminishing, the research community is forced to urgently address this major issue until more abundant efficient electrocatalysts are put forward. In this respect, high-aspect ratio carbon nanostructures can provide an excellent mean for the fabrication of highly durable electrocatalyst materials through platinum encapsulation, allowing their sustainable use in fuel cells technology.

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