COVER IMAGE

Spin transport and dynamics in the solid state continue to provide intriguing fundamental results and to generate ideas for new devices based on the manipulation of the electron spin, as well as its charge.

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Spintronics

Spintronics is the area of condensed-matter physics that studies the properties of the electron spin, with a view to improve the efficiency of electronic devices and to enrich them with new functionalities.

Such a broad definition implies that the range of subjects that fall under the umbrella of spintronics is inevitably very wide. In one extreme, researchers explore the control of single localized spins, realized on single atomic sites in crystals — such as nitrogen-vacancy centres in diamond — or in semiconductor quantum dots. These are regarded as spin qubits, ideal for quantum computation in a solid-state environment. At the other extreme, researchers explore spin transport and spin dynamics in macroscale systems, coupling spin transport to spin dynamics in many ways. It is this regime that is the focus of this *Nature Materials* Insight.

The field is evolving rapidly and many exciting developments in fundamental physics and materials science have occurred only in the past few years. Condensing the progress of such a broad field within the fifty pages of this supplement would be senseless. We felt, however, that a selection of topics deserved summarizing for our readers in a compact, yet comprehensive format.

The five areas that we have chosen to highlight all have a degree of technological prospect, albeit in some cases this is more concrete than in others. It is fair to say that this potential for application has been a major drive for the field so far. The success story of giant magnetoresistance and its broad application to information technology — which earned Albert Fert and Peter Grünberg the Nobel Prize in Physics in 2007 — has certainly contributed to this. But it would be a fallacy to consider the eventual applications more important than the fundamental insight provided by spintronics research. The spin is a purely quantum-mechanical entity and its interaction with the electron charge or the atomic environment provides a unique opportunity to understand the quantum nature of matter.

Given the rapid pace at which spintronics is advancing, it is not improbable that some of the contents of this Insight will age quickly, but we do not consider this to be a shortcoming. Rather, we hope that for the near future our Insight will serve as a reference point from which to follow the developments in this exciting field.

Fabio Pulizzi, Senior Editor

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