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Editorial corner – a personal view
A 'backstage force': magnetic properties of polymer composites

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Although electromagnetic force belongs to the fundamental interactions of nature, and its existence was known even from the ancient times, limited research work concerns magnetic properties of polymer composites. The lack of significant magnetic properties in polymers focused the interest on their mechanical, thermal, electrical, optical and anti-corrosive response. Initial scarce efforts concerned microcomposites with Fe, Ni, Co or iron oxide, in the form of micro-powder or fibres, as the magnetic reinforcing phase. The achieved magnetic performance remained below expectations, even at high filler loading, where substantial degradation of mechanical behaviour occurred.

The situation became different with the era of nanocomposites. The philosophy of inorganic/organic synergy at the nanoscale level gave a new impetus in magnetic polymer composites. The response of magnetic nanoinclusions (particles, fibres or lamellae) differs from their bulk counterparts, due to their dimensions and their properties appear to be size dependent. Metals and alloys (e.g. Fe, Ni, Co, FePt), oxides (e.g. γ-Fe_2O_3, Fe_3O_4 or cobalt oxides) and ferrites (e.g. $BaFe_{12}O_{19}$) are currently employed as magnetic fillers. Magnetic materials are classified into soft and hard magnets and according to the ordering, in the absence of a magnetic field, of the atomic magnetic moments to:

(i) ferromagnetic (with equal magnetic moments aligned in the same direction),
(ii) antiferromagnetic (with antiparallel equal magnetic moments) and
(iii) ferrimagnetic (with antiparallel unequal magnetic moments).

The various types of magnetic materials and Verway or spin-glass transition observed (at least) in magnetite, still being a matter of scientific debate, offer versatility in selecting the appropriate nanoreinforcement and thus defining/controlling the magnetic performance of nanocomposites.

The presence of magnetic nanoinclusions besides magnetic response influences the electrical properties and in combination with the polymer matrix benefits enhances nanocomposite's multifunctionality. Magnetic nanocomposites appear to be useful in designing materials suitable for applications in the fields of biomedicine, magnetic resonance imaging, information technology, telecommunication, damage detection techniques, electromagnetic interference etc.

Thus, a deeper understanding of magnetic phenomena and interactions at the nanoscale, will bring a 'force from backstage' in the technological front.

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