The study of collective spin excitations in magnetically ordered materials (so-called spin waves and the associated quasi-particles—magnons) has a successful history of more than 60 years. Recently, it has re-emerged in a new aspect under the name of magnonics, although the exact definition of its scope is still a subject for debate. However, it is widely accepted that the recent renaissance of interest in spin waves has been driven by three major factors: the rapid advance of nanotechnology, the development of new experimental techniques for studying high-frequency magnetization dynamics and the promise of a new generation of functional magnetic field controlled devices in which spin waves (magnons) would be employed, in particular to carry and process information. Furthermore, the growing interest in man-made 'crystals', such as those already realized in photonics, electronics and plasmonics, has served as a further strong catalyst for the development of so-called magnonic crystals. Magnonics as a research field is currently gaining momentum, attracting more and more researchers from various sub-fields of magnetism, materials science, microwave engineering, and beyond. Hence, it is timely to define the state of the art of this exciting research field emerging at the interface between magnetism and nanoscience.

The first magnonics conference, entitled ‘Magnonics: From Fundamentals to Applications’ was held in Dresden in August 2009, sponsored by the visitor programme of the Max Planck Institute for the Physics of Complex Systems (MPIPKS). The event was a great success, having achieved its main aim of forming a community of magnonics researchers. It brought together both experts who held worldwide leading positions in nanomagnetism and spin wave research, and younger researchers just entering the field. The research results presented ranged from fundamental magnonic properties to their application in information technologies. The main scientific result of the conference in the broader sense was the emergence of magnonics as a sister field in the family of functional nanomaterials that also includes electronics, photonics, phononics, plasmonics etc. The presentations helped to define the state of the art and to highlight perspectives of the field. The conference led to the idea of publishing this cluster of papers aimed at reviewing the history of and the recent progress in magnonics.

The cluster begins with a contribution from Kruglyak et al who aim to define the general scope and concepts of magnonics as a research field [1]. Serga et al review the state of the art in studies of spin waves in yttrium iron garnet (YIG) samples, which—due to the exceptionally low magnetic losses—have been the most popular and extensively investigated so far [2]. Gubbiotti et al review their recent experiments in which the magnonic band gap spectrum was observed in planar metallic magnonic crystals with submicrometre periods [3]. Kim demonstrates how numerical simulations can be used to investigate a wide range of magnonic phenomena in truly magnetic nanostructures, which still remains a challenge for modern experiments [4]. Finally, Khitun et al discuss the prospects and challenges for the creation of magnonic logic devices [5]. As with any dynamic research field, the reviews are inevitably incomplete. Nonetheless, we hope that the cluster of papers will stimulate further progress in magnonics and will provide a useful starting point for researchers newly entering this challenging and exciting research field.
References