FOREWORD

Focus on Materials Analysis and Processing in Magnetic Fields

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Recently, interest in the applications of feeble (diamagnetic and paramagnetic) magnetic materials has grown, whereas the popularity of ferromagnetic materials remains steady and high. This trend is due to the progress of superconducting magnet technology, particularly liquid-helium-free superconducting magnets that can generate magnetic fields of 10 T and higher. As the magnetic energy is proportional to the square of the applied magnetic field, the magnetic energy of such 10 T magnets is in excess of 10 000 times that of conventional 0.1 T permanent magnets. Consequently, many interesting phenomena have been observed over the last decade, such as the Moses effect, magnetic levitation and the alignment of feeble magnetic materials. Researchers in this area are widely spread around the world, but their number in Japan is relatively high, which might explain the success of magnetic field science and technology in Japan.

Processing in magnetic fields is a rapidly expanding research area with a wide range of promising applications in materials science. The 3rd International Workshop on Materials Analysis and Processing in Magnetic Fields (MAP3), which was held on 14–16 May 2008 at the University of Tokyo, Japan, focused on various topics including magnetic field effects on chemical, physical, biological, electrochemical, thermodynamic and hydrodynamic phenomena; magnetic field effects on the crystal growth and processing of materials; diamagnetic levitation, the magneto-Archimedes effect, spin chemistry, magnetic orientation, control of structure by magnetic fields, magnetic separation and purification, magnetic-field-induced phase transitions, properties of materials in high magnetic fields, the development of NMR and MRI, medical applications of magnetic fields, novel magnetic phenomena, physical property measurement by magnetic fields, and the generation of high magnetic fields.

This focus issue compiles 13 key papers selected from the proceedings of MAP3. Other papers of the proceedings are published in *Journal of Physics: Conference Series*. Tournier and Beaugnon review experimental texturing in metallic melts by cooling in magnetic fields, which is modeled in detail in a study by Tournier. Wang *et al* provide further experimental results on the solidification of Mn-90.4 wt % Sb alloy in magnetic fields. The orientations of grains and particles induced by magnetic fields is reported by Horii *et al* (rare-earth-doped cuprates), Tanaka *et al* (barium-bismuth titanate ceramics), Liu and Schwartz ($Bi_2Sr_2CaCu_2Ox$/AgMg wires) and Tsuda and Sakka (carbon nanotubes). Gielen *et al* present a model of how to quantify a molecular alignment using magnetic birefringence, and Ando *et al* simulate the movement of feeble particles in magnetic fields. Hirota *et al* report the experimental control of the lattice constant in a triangular lattice of feeble magnetic particles. The size separation of diamagnetic particles by magnetic fields is experimentally studied by Tarn *et al* and theoretically studied by Fukui *et al*. A setup measuring x-ray diffraction patterns in magnetic fields up to 5 T and temperatures above 200 ^{o}C has been developed by Mitsui *et al*.

We hope that this focus issue will help readers to understand several aspects of materials analysis and processing in magnetic fields at the frontier of the science.

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