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Preface

It was a surprise for the superconductivity community when such a simple (and previously known) material exhibited high temperature superconductivity at 40 K. Numerous experimental and theoretical works were reported within the next two years. The previous special issue of Physica C on MgB_2 was rapidly published in 2003, collecting excellent review papers about various experiments and theoretical calculations.

However, not all problems were solved theoretically or clarified experimentally at that stage. After the publication of the previous special volume, further progress has been made both in experiment and theory. For example, new detailed calculations have changed our understanding of the anharmonic effects, casting serious doubts on the existing understanding of the isotope effect. First principles calculations for the Coulomb repulsion effect on superconductivity have become feasible and have raised the theory to the next level, while at the same time posing new questions.

A much more complete mapping of fundamental physical quantities such as optical spectra and phonon dispersion has been accomplished. More precise and more variegated monitoring of the two gaps' evolution has become possible, including, for instance, direct observation by angle-resolved photoemission spectroscopy. Some preliminary reports have appeared on the collective mode predicted for two-band superconductors by Leggett many years ago. These and other successes can be largely credited to overcoming the problems related to the small crystal size and rapid surface degradation.

Substantial effort has been invested in studying doping and impurity effects, including the theoretically predicted gap merging upon introducing impurities and/or irradiation. On the other hand, the suppression of T_c down to 10 K or lower by irradiation was unexpected.

Major progress has been made in applications, with much attention paid to increasing J_c and H_{c2} in bulk materials, films and wires. An extraordinarily high H_{c2} over 60 Tesla was recorded in textured films. A prototype of an MgB_2-based magnet has already been produced.

Considering all this progress in the research of MgB_2, we publish a second special issue of Physica C on MgB_2, covering results reported after 2003. This collection of invited review papers reflects the MgB_2 results as of December, 2006.

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