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PREFACE

Preface

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This Special Issue presents a selection of papers describing recent progress in the search for new materials with T_c approaching room temperature.

Two important steps in this direction should be highlighted. In 1986, G. Bednorz and K. A. Müller found that certain oxides containing copper ions displayed high critical temperatures. This was quickly followed by vigorous research and further advances. Several cuprate families with T_c above liquid nitrogen temperature and even above 100 K were identified. Since cuprates have a layered structure, their discovery has stimulated intensive theoretical studies of systems with reduced dimensionality. In the meantime, the key question regarding the mechanism of high T_c superconductivity in the cuprates remains controversial.

The next important step was taken in 2015 by M. Eremets and his group who demonstrated the superconducting state in the hydride H_3S with T_c exceeding 200 K. This phenomenon was observed under megabar pressure: an increase in pressure leads to structural transitions. The existence of the high T_c phase had been predicted by D. Duan and her collaborators in 2014. As for the mechanism, it is presently generally accepted that high T_c in the hydrides is caused by the strong coupling of electrons with high-frequency hydrogen vibrations.

Thus, materials with near-room-temperature critical temperatures have been achieved, but they require the use of extremely high-pressure techniques.

The Special Issue also contains a paper by C. W. Chu and his collaborators. Prof. Chu and his group have made key contributions to the study of cuprates, including the discovery of the famous $YBa_2Cu_3O_7$, the first material with T_c approaching 100 K. In this issue, they describe novel studies of materials capable of retaining the high-T_c state after the removal of high pressure.

Unfortunately, any sample housed in a diamond anvil cell is not practical for applications. It is therefore valuable to pursue alternative approaches.

Two papers in this Special Issue describe other promising directions. V. V. Kresin and his group have provided evidence for high-temperature superconductivity in size-selected metal nanoclusters with a quantized electronic level structure.

I. Felner describes studies of sulfur-doped amorphous carbon and other interesting observations.

All papers in this Special Issue have been submitted by invitation. We are grateful to all authors for their contributions.

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