Foreword

CRC799 Contribution

The Technische Universität Bergakademie Freiberg, Germany, was founded 250 years ago in 1765 as a School of Mining and Technology in Freiberg, Germany, based on old tradition of mining for silver ores and non-ferrous metallurgy in Ore Mountains, Germany. Thus, from the early beginning, non-ferrous metallurgy was a major topic. Later on, Adolf Ledebur was appointed for a professorship in ferrous metallurgy in 1874, founding an institute for research and education on iron and steel. Based on this 250-year-old tradition, materials science and technology is one of the key topics in research and education at our University today with a total of 15 professors working in fundamental and applied subjects of metals, ceramics, composites, and structure and property analysis as well as modeling.

In 2008, a collaborative research center with the title ''TRIP-matrix composites - Design of tough and transformation toughened composite materials and structures based on Fe-ZrO_2'' was founded with financial support of German Research Foundation (Grant No. SFB 799). Within this center, about 25 scientists as Ph.D. candidates and PostDocs are working on different topics of composite materials based on high-alloy austenitic stainless CrMnNi steels and MgO partially stabilized zirconia. Both components show phase transformations: (i) the steel may undergo a deformation-induced martensitic phase transformation from the austenitic γ-phase to the α'-martensite *via* the so-called ε-martensite giving the TRIP-effect (transformation-induced plasticity) and (ii) the ceramic reinforcement exhibits a stress-assisted martensitic phase transformation from the tetragonal to the monoclinic crystal structure. Moreover, depending on chemistry and/or temperature, the steel shows mechanical twinning yielding the twinning-induced plasticity effect (TWIP-effect). Thus, by choice of the steel composition, different properties can be set in terms of strength and strain to failure. Finally, the different effects are combined to yield damage-tolerant composite materials.

The composites as well as unreinforced reference materials are made either by powder metallurgy or by casting and/or infiltration of porous ceramic preforms. Besides subprojects dealing with new processing technologies to obtain bulk composites (by sintering, hot pressing, or forming) or cellular materials (as *e.g.*, square-shaped extruded honeycombs, foams, or beads), the microstructures and the deformation and failure mechanisms are studied in detail *postmortem* as well as by *in situ* experiments. These activities are complemented by several subprojects on modeling and simulation of processes, thermochemistry, and properties of the new materials. Moreover, the Ph.D. candidates are trained in an integrated graduate school.

In the present issue of Metallurgical and Materials Transactions A, we present a couple of original research articles covering aspects of the new CrMnNi steel grades, such as deformation mechanisms at different temperatures (Martin *et al.*), the Portevin-Le Chatelier effect (Müller *et al.*), deformation at strain rates higher than 10^4 s^{-1} (Eckner *et al.*), cyclic deformation at different temperatures (Biermann *et al.*), phase transformations up to high hydrostatic pressure of 17 GPa (Ackermann *et al.*), and a modeling approach for prediction of the mechanical properties (Weiß *et al.*). Subsequently, a new technique to achieve functionally graded materials by electron beam treatment and local reversion annealing and recrystallization (Heinze *et al.*) and new VN-hardened steel grades (Wendler *et al.*) are presented. For thermodynamic modeling, the CALPHAD technique is used (Fabrichnaja *et al.*). Finally, new approaches for composite materials are discussed, *i.e.*, a slurry-based method to yield composite paper (Wenzel *et al.*) and a spark-plasma sintering technique (Decker *et al.*).

The given selection covers only a small part of the activities of the collaborative research center, and the readers are invited to find more information and references to further published articles on our website (sfb799/tu-freiberg.de).

Finally, we wish to thank the editor and the journal for the possibility to present this selection to give the readers an overview on our activities. Moreover, we thank German Research Foundation for meanwhile seven years of funding giving us the possibility to carry out basic research on several exciting materials and techniques. We hope that the readers will find interesting articles and will go to further details of our work.

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