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Preface to the special section on high-temperature capillarity

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During the first decades of development of Materials Science and Engineering, the emphasis of both research and education was on identifying the phases and understanding their properties as a function of their structure, composition and temperature (sometimes this list was extended to pressure, or to electric, magnetic and gravitational fields, or even to the effect of deformation in case of solid materials).

Although the role of interfaces on properties of real materials has been appreciated for a long time, research in this field has been accelerated only in recent decades. As an example, engineering of grain boundaries today is equally as important as engineering of the grains themselves. Simulation of the microstructure evolution in various materials relies on the (mostly missing) knowledge of interfacial energies between various phases as a function of the compositions of the surrounding phases and temperature. Moreover, not only a single value of interfacial energies is needed: as phase compositions and temperature vary during cooling of the material, a functional relationship between these state parameters and various interfacial energies are needed for proper simulation at high temperatures. This knowledge is requested even more to understand and design nano-materials with desired properties. (Nano-materials are those which contain at least one nano-phase, i.e. a phase with at least one of its dimensions below 100 nm; thus, nanomaterials are materials whose properties are defined more by their inner interfaces rather than by their phases.)

Further, HTC (high-temperature capillarity) phenomena play a crucial role in everyday practice of all metal making (steel, aluminium, copper, even silicon,

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etc.), metal joining (welding, brazing, soldering) and other materials industries. The HTC conference series was initiated in 1994 by leading scientists in the field of their time Eustathopoulos (France–Greece), Naidich (Ukraine) and Sangiorgi (Italy). This special issue contains some of the papers presented at the 9th HTC conference organized for the first time electronically at the University of Miskolc (Hungary) during the period 22–25 June 2020 by George Kaptay and Peter Baumli.

The six papers collected here represent a diverse mix of topics from the conference. One paper deals with the wettability of TiC reinforcements in aluminium matrix composites, which is of fundamental importance in determining the mechanical properties of the composite (R-F. Guo et al.). A paper on the same topic deals with the wettability of carbon nanotubes in aluminium (H-Z Shen et al.). Another paper deals with the effect of surface tension on Marangoni flow in steel processing (T. Matsushita et al.). The paper by B. Straumal et al. investigates the wetting of grain boundary triple junctions in Cu-In alloys. The final paper deals with wetting and interfacial reactivity between Ni-Al alloys and ceramic reinforcements (F. Valenza et al.).