

Preface

“Capillarity” has attracted the attention of many distinguished scientists since the very beginning of the 19th century.

The years 1804–06 should be considered as a milestone: two important contributions appeared, namely by Thomas Young [presented at The Royal Society in December 1804] and by P.S. de Laplace in 1806, who, on the basis of a deep analysis of the influence of forces acting at the interfaces, drew a correct description of both the elevation of liquids in capillary tubes and the contact angle. In the Laplace’s work, the equation for the mechanical equilibrium of a capillary surface, still the basis of nearly all measurement techniques of surface tension, was first derived.

The advent of the Space Era, with the possibility of experimenting in low-gravity environment (microgravity), offers the challenge to study fluid systems under conditions where the surface tension forces are not counteracted by weight: thus, it has become possible to realise efficient levitating means, to study the adsorption under purely diffusive conditions, to set up new and more precise measurement techniques for surface tension, adsorption and surface elasticity, to study coalescence and dispersion phenomena without the masking effects of sedimentation and, finally, to conduct thorough studies of surface motions driven by local surface tension unbalances: the *Marangoni effects*.

The International Conference on High-Temperature Capillarity (HTC-2004), the fourth in a series which started in 1994 in Smolenice (Slovakia), was held March 31 to April 3, in Sanremo, Italy, under the auspices of the Italian National Research Council (CNR) Institute for Energetics and Interphases.

The conference was opened by the 1991 Nobel Laureate in Physics, Prof. Pierre-Gilles de Gennes, who presented a lecture on the interpretation of a wide spectrum of capillary phenomena and their relation to the intrinsic molecular characteristics of the different phases in contact, thus making the bridge between the “low-” and the “high-” temperature communities.

The conference commemorated the 200th anniversary of Young’s publication of the relationship that defines the wetting angle, with a historical retrospective by Prof. E.D. Hondros titled “Thomas Young, Natural Philosopher,” and a dedicated session covering highlights of the application of Young’s equation in high-temperature capillarity.

Within a format of a single venue for all presentations, with no parallel sessions, the conference presented topics that ranged from fundamental capillary science, where both old and new ideas and data were presented in a relevant context, to practical process-related applications involving high-temperature wetting and joining phenomena in metals and ceramics. Some of the new experimental techniques—especially high-resolution electron microscopy, including grain boundaries and the impressive atomic-resolution movies of the tips of advancing wetting films at surfaces—provided insight into phenomena at heterogeneous interfaces formed by the wetting of dissimilar materials.

Since the last HTC conference in 2000, there has been a significant increase in presentations on capillary phenomena at grain boundaries, a topic in high-temperature capillarity that has many important ramifications in materials science such as grain-boundary embrittlement by liquid-metals. Moreover, the coverage of the basic science of capillarity at high temperatures was coupled with discussions of technological problems such as the relevant studies on the role of the dynamic transfer of oxygen from the gaseous phase to the liquid-metal surface (with its direct consequences on the influence of oxygen partial pressures on the surface tension of liquid metals) and the effects of Marangoni convection on welding pool shape. The conference benefited from the participation of theoretical groups modelling problems such as contact angles at metal/ceramic interfaces, surface melting, and metal/ceramic interfacial energies. Indeed, on these subjects, an impressive progress has been accomplished during the last few years.

Important studies were also been presented on new experimental techniques, on the wettability and joining of special ceramics, and on the effects of roughness and of pre-defined surface patterns on contact angles. The importance of dynamic phenomena in the analysis of high-temperature behaviour of molten materials (so-called real-time tests) was addressed.

With the attendance of more than 130 scientists from 19 countries, the international flavour of this conference gave a sense of just how geographically broad this highly focused field has become.

The Editors would like to express their gratitude to all the Members of the Scientific Committee and of the Organising Committee for the time and effort they have given in order to ensure the successful outcome of this Conference.

The generous support of many sponsoring organisations is also gratefully acknowledged.

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