Editorial

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Biographical notes: Paulo Bártolo is Professor on Advanced Manufacturing Processes at the Polytechnic Institute of Leiria (Portugal), Head of the Mechanical Engineering Department at the School of Technology and Management of the Polytechnic Institute of Leiria, member of the executive Committee of the Postgraduate Research Centre of the Polytechnic Institute of Leiria, and member of the Institute of Polymers and Composites at the University of Minho (Portugal). Dr. Bártolo's areas of research include reverse engineering, rapid prototyping, rapid tooling and biomimetics.

David Bourell is a Temple Foundation Professor at The University of Texas at Austin in the Departments of Mechanical Engineering (ME), and Materials Science and Engineering (MS&E). He received a master's degree and PhD degree from Stanford University in Materials Science and Engineering. He is a Fellow of ASM International. Dr Bourell was a recipient of the ASM International Bradeley Stoughton Award for Outstanding Young Teachers of Metallurgy. Dr. Bourell's areas of research include particulate processing with emphasis on power synthesis, sintering kinetics and densification, and materials issues associated with selective laser sintering.

On October 2003, the Polytechnic Institute of Leiria (Portugal) hosted the First International Conference on Advanced Research in Virtual and Rapid Prototyping. The Conference carried out a full paper submission refereeing process resulting in just 103 papers. A number of these papers dealt with Materials and Product Technology. These papers were resubmitted in an extended form and then further reviewed prior to publication. Subsequently, seven top quality papers were selected for publication in this special issue of the *International Journal of Materials and Product Technology*.

The first paper by Jardini and coauthors, introduces a novel rapid prototyping process based on stereolithographic principles, called Infrared Laser Stereolithography, a process that uses an infrared laser beam to cure a thermosetting material. Its optimisation in terms of both speed and accuracy, requires a proper balance and control of several parameters such as laser power, pulse repetition rate, scanning frequency and scanning speed, size of the laser beam and resin composition. The results of an extensive undertaking of experimental and computer simulation research are presented, supporting the use of infrared radiation for further optimisation of stereolithographic processes.

The next two papers are also focused on stereolithography, a topical research field where novel materials and fabrication principles can open new and promising frontiers for stereolithography. Rosen and coauthors propose a novel analytical model for the curing behaviour of stereolithographic resins, based on a mechanistic description of cure incorporating photo-initiation rates, diffusion and temperature distributions to get a better understanding of the solidification process. This computer model will enable the study and development of novel materials with improved mechanical properties and shrinkage effects.

Stute and coauthors are developing a new stereolithographic strategy exploring a deeper understanding of the photo-curing process and the interaction radiation-polymer. They present a two-photon polymerisation process that is a truly a three-dimensional micro-fabrication process, contrary to conventional stereolithography that is a planar process. This new technology can be used for rapid prototyping and low-cost fabrication of micro and nanostructured components.

The final three papers of this issue cover different topics of research regarding materials aspects of rapid prototyping.

Stampfl and coauthors explore the fabrication of cellular materials through rapid prototyping for biomedical applications. The ideal material for these applications must be biodegradable and biocompatible, so the use of rapid prototyping poses a problem regarding the materials used. The generation of scaffolds for tissue engineering may imply the use of rapid prototyping to produce an appropriate mould of the scaffold structure and then a secondary process involving the casting of an appropriate biomaterial, as described in this paper.

The Ramos and Bourell paper focuses on the use of non-tactile laser polishing for surface finishing of commercial selective laser sintered iron–copper parts. Surface finishing is a major barrier to achieving functional parts through selective laser sintering (SLS), so this topic of research is particularly important. The results point out a promising technique enabling a considerable reduction in surface roughness of SLS parts at fast processing rates.

Duarte and coauthors present a chain of integrated processes to convert models made by rapid prototyping or other conventional techniques into metallic moulds. The main goal of this chain is to rapidly obtain prototype tools by casting a metal into a ceramic mould previously obtained by rapid tooling. This is an experimental work, which can be of great interest, especially for mould-makers.

The last paper of this issue focus on nanomanufacturing, an area that closely parallels rapid prototyping (see for example the case of micro-stereolithography, atomic manipulation and 2-photon polymerisation processes). Chryssolouris and coauthors review different nanomanufacturing approaches and techniques emphasising the main drivers and opportunities.

We are grateful to all authors and reviewers of papers selected for this special issue. Finally, our thanks to Dr. Mohammed Dorgham, the Editor-in-Chief, for his support regarding this special issue.