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RTO MEETING PROCEEDINGS 9

Intelligent Processing of High Performance Materials

(le Traitement sophistiqué de matériaux très performants)

Papers presented at the Workshop of the RTO Applied Vehicle Technology Panel (AVT) (organised by the former AGARD Structures and Materials Panel) held in Brussels, Belgium, 13-14 May 1998.

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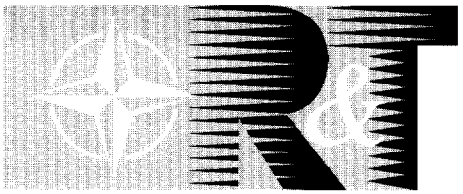

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RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also coordinates RTO's cooperation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of initial cooperation.

The total spectrum of R&T activities is covered by 6 Panels, dealing with:

- SAS Studies, Analysis and Simulation
- SCI Systems Concepts and Integration
- SET Sensors and Electronics Technology
- IST Information Systems Technology
- AVT Applied Vehicle Technology
- HFM Human Factors and Medicine

These Panels are made up of national representatives as well as generally recognised 'world class' scientists. The Panels also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier cooperation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

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Intelligent Processing of High Performance Materials

(RTO MP-9)

Executive Summary

Intelligent Processing of High Performance Materials (IPM) is an emerging methodology for simulating and controlling the processing and manufacture of materials. The main driver for this methodology is to improve quality and reduce the costs associated with advanced materials. The increasing focus on affordability has resulted in a shift from product technology development, which in the past has led to increasingly expensive military systems, to development of process technologies which offer the promise of achieving technology affordability while maintaining or improving product quality. The growing interest in affordable process technologies is exhibited by the proliferation of programs addressing "flexible," "agile," and "intelligent" manufacturing, concurrent engineering, integrated product and process development, and "lean" aircraft production. In addition to its role in intelligent manufacturing systems of the future, IPM offers significant near-term advantages in the production of higher quality, more affordable military systems.

A very successful Workshop on Intelligent Processing of High Performance Materials was held by the former AGARD Structures and Materials Panel on 13 and 14 May 1998 in Brussels, Belgium. A total of sixteen papers were presented on a wide range of subjects related to IPM. These included an overview of the topic, analytical techniques associated with IPM, and applications of IPM to both metallic and non-metallic materials. In the Round Table Discussion at the end of the Workshop, recommendations for current needs and future developments were discussed. It was suggested that a Working Group be formed to develop and exchange "bench-mark" properties to be used for IPM since one major road block in its implementation is the lack of data available for the dynamic process involved in IPM. This could be accomplished by the use of the Internet to exchange information, properties, and testing techniques.

Le traitement sophistiqué de matériaux très performants

(RTO MP-9)

Synthèse

Le traitement sophistiqué de matériaux très performants (IPM) est une méthodologie naissante pour la simulation et le contrôle de la fabrication et du traitement des matériaux. L'objectif principal de cette méthodologie est d'améliorer la qualité des matériaux avancés et de réduire les coûts associés. La pression croissante sur les coûts a entraîné un changement d'orientation. Auparavant basé sur les technologies des matériaux, responsables de la flambée des prix des systèmes militaires, le développement s'appuie maintenant sur les technologies des procédés, plus abordables sur le plan financier et garantes du maintien voire de l'amélioration de la qualité des produits. L'intérêt grandissant manifesté pour les technologies de système est démontré par la prolifération de programmes visant la fabrication "souple", "agile" et "intelligente", l'ingéniérie concurrente, le développement simultané du concept et des produits et la production aéronautique à moindre coût. En plus du rôle qu'il jouera dans les systèmes de fabrication intelligents à l'avenir, l'IPM offre des avantages considérables dans le court terme, en ce qui concerne la production de systèmes militaires de meilleure qualité à des coûts d'acquisition plus acceptables.

L'atelier sur le traitement sophistiqué des matériaux très performants organisé du 13 au 14 mai 1998 à Bruxelles par l'ancien Panel AGARD des structures et matériaux a connu un franc succès. En tout, seize communications ont été présentées sur des sujets se rapportant à l'IPM et notamment un exposé général de la question, les techniques analytiques associées à l'IPM, et les applications de l'IPM aux matériaux métalliques et non métalliques. Un certain nombre de recommandations concernant les besoins actuels et les développements futurs ont été faites lors de la table ronde qui a clôturé la séance. Il a été proposé de créer un groupe de travail afin de développer et d'échanger les caractéristiques de référence à utiliser pour l'IPM puisque l'un des principaux obstacles à sa mise en œuvre s'avère être le manque de données relatives aux processus dynamiques de l'IPM. Ceci pourrait être accompli en se servant d'Internet pour l'échange d'informations, de caractéristiques et de techniques d'essais.

Contents

SESSION III: METALLIC MATERIALS APPLICATIONS II

SESSION IV: NON-METALLIC MATERIALS APPLICATIONS

Preface

Intelligent Processing of High Performance Materials (IPM) is an emerging methodology for simulating and controlling the processing and manufacture of materials. It is finding widespread application during the manufacture of electronic, photonic and composite (i.e. high performance) materials, as well as primary metals such as steel and aluminum. IPM simulation tools seek to create, at the level of an engineering workstation, a "virtual" version of a process. They combine process models for a material's response to processing stimuli (e.g. pressure, temperature, and environmental conditions) with characteristics of the process equipment to predict the material's performance defining attributes at the completion of the process. Thus, they provide a methodology for the process engineer to conduct "what if..." trials in minutes or hours compared to weeks or months of practical experimentation, and for near optimal processing approaches to be identified. IPM controllers are an innovative extension of today's state-of-the-art in control technology. They exploit the recent availability of non-invasive sensors that sense critical product variables during the process. This new knowledge about the state of the process, together with process models, can be used to plan and execute feedback control schemes leading to products with "goal state" combinations of performance defining property attributes. This radically new approach to process control enables the processing of high performance materials hitherto considered too unstable for commercialization and significantly improves the yield/quality of those already being manufactured today.

The objectives of the NATO RTO Workshop were to examine state-of-the-art analytical techniques and application of these techniques to metallic and non-metallic materials. An additional objective was to identify research and development needs for further implementation of IPM methods for cost reduction and quality improvement.

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Polymers	IPM (Intelligent Processing of Materials)
Process control	Curing
Cost engineering	Lasers
Quality control	Melting

14. Abstract

Contains the papers presented at a Workshop on Intelligent Processing of High Performance Materials organised by the Applied Vehicle Technology Panel (AVT) of RTO, in Brussels, Belgium, 13-14 May 1998.

The papers describe various aspects of intelligent processing, a methodology for simulating and controlling the processing and manufacture of materials, which is finding widespread application during the manufacture of functional electronic, photonic and composite materials as well as primary metals such as steel and aluminium.

The papers are presented under the following headings:

- Overview and analytical techniques
- Metallic materials applications
- Non-metallic materials applications

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