Tempus Project University of Kragujevac
WBCVMnet
WBC Virtual Manufacturing Network
Fostering an Integration of the Knowledge Triangle

European Commission
TEMPUS

Project Kick-off Meeting
Kragujevac
March 24-26, 2009

DIMEG - Centre for Precision Forming and Manufacturing

DIMEG
Università di Padova, Italy

S. Fanini , P.F. Bariani

*tecno*DIMEG

- 1 full professor
- 1 associate professor
- 4 assistant professors
- 2 post-docs
- 12 PhD students

www.dimeg.unipd.it\tecno

EU Projects

- Brite-Euram ***EFFORTS*** “Enhanced framework for forging design using reliable three-dimensional simulation” 1997-2000
- Brite-Euram ***FAT-LIFE*** “Optimisation of the service life of production tools in hot forging, die casting and glass forming by minimising the risks related to thermal fatigue” 1997-2001
- Thematic Network ***WAFAM*** “Warm forging of advanced metal alloys” 1998-2002
- Growth ***IMPRESS*** “Improving of Precision in forming by simultaneous modelling of deflections in workpiece-die-press system” 2001-2005
- Craft ***RING*** “An integrated system to check the dimensions of shaped rings during production phase” 2002-2004
- Eureka-Factory ***DECOFOR*** “Innovative system for the design and control of a precision forging process with integrated quality assurance” 2002-2006
- Eureka-Factory ***RINGING*** “Novel environment integrating process design and control for the ring rolling of net shape complex profile products” 2003-2006
- EU Coordinate Action ***VIF-CA*** “Virtual Intelligence Forging” 2004-2007.
- Craft ***OP3MET*** “Optical 3D Metrology – Automated in-line metrology for quality assurance in the manufacturing industry” 2006-208.
- Cornet ***LORCOT*** “Loaded-Related Design of Coatings for Forming Tools” 2008-2009.
- Leonardo ***MAIATZ SIMULFORM*** “Transfer of research results on numerical 3D simulation technologies applied on cold forming process to VET and Continuous Learning on metal-mechanics sector”.

Metal Forming / Bulk

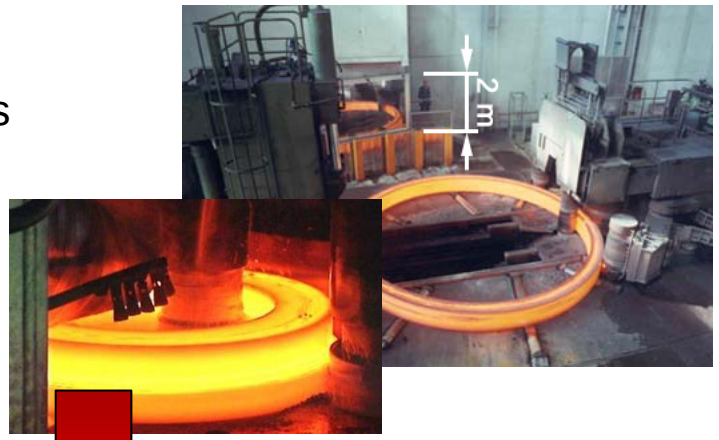
INTEGRATED DESIGN

Material

Study of the rheological behavior.
Determination of the phase transformation curves..
Determination of the flow curves.

Process

Modelling for the process parameters optimization.
Process parameters influence on the material behavior.
Phase transformation influence.
Numerical Simulation.



Final technological properties

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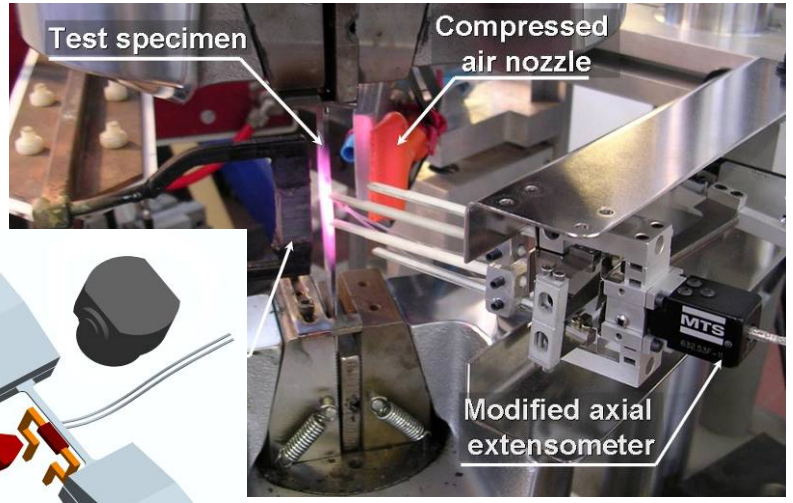
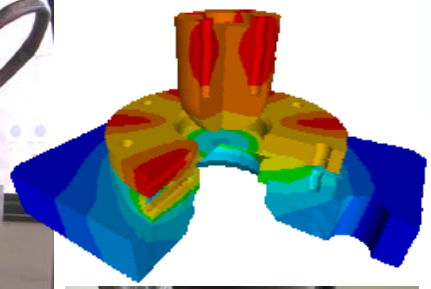
Mechanical behavior

Metal forming / Sheet Metal

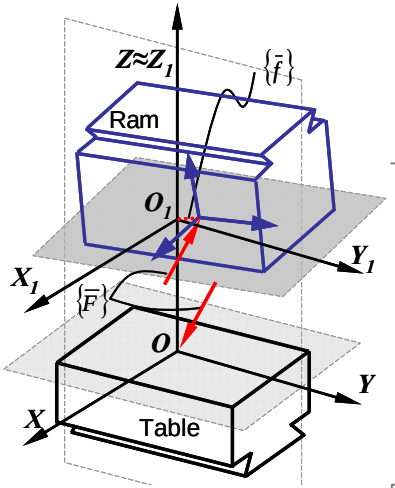
Material behavior under process condition
Determination of the flow curves.
Study of the material anisotropy and its evolution.
Elastic-plastic properties determination.
Phase transformation influence.



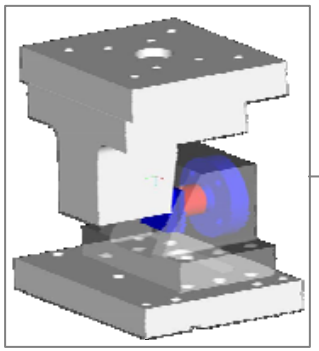


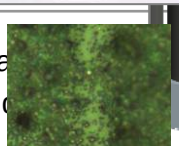
Formability of metallic sheets
Nakazima test at room and elevated temperature (hot stamping).
Physical simulation of the process.
FE numerical models calibration.
Determination of the material formability curves.

Metal forming / Machines

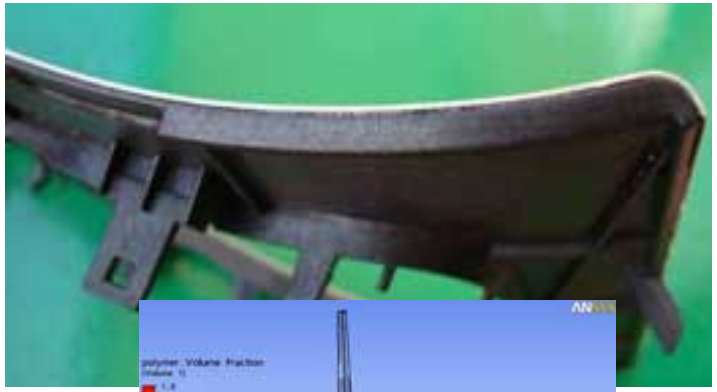


	F_x	F_y	F_z	M_A	M_B	M_C
Δx						
Δy						
ΔA						
ΔB						
ΔC						



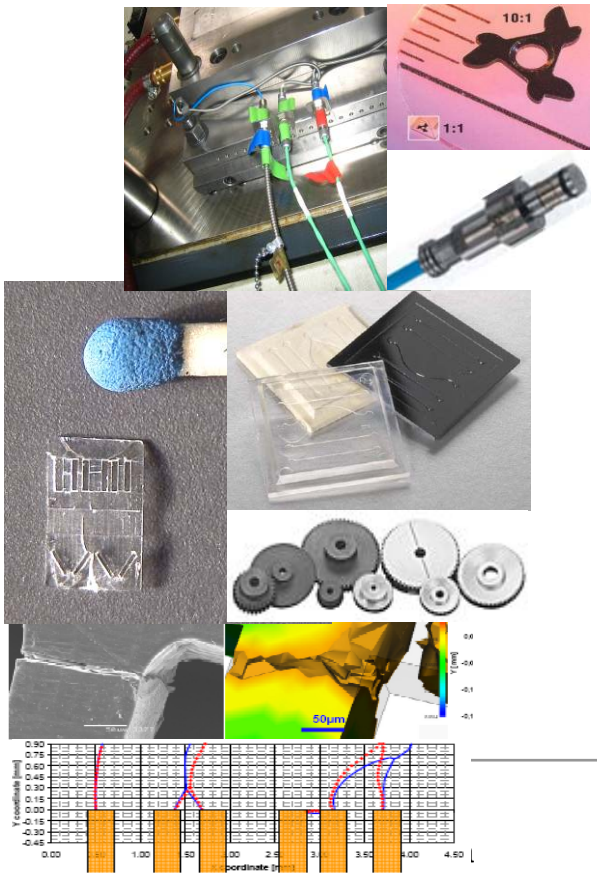


Polymer Processing /1



Sheet metal - Polymer composite forming process

Design and prototyping of a Polymer Injection Compression Forming (PICF) process system.
Multi-physics numerical simulation of PICF process.
Analysis and optimization of sheet metal – polymer coupling



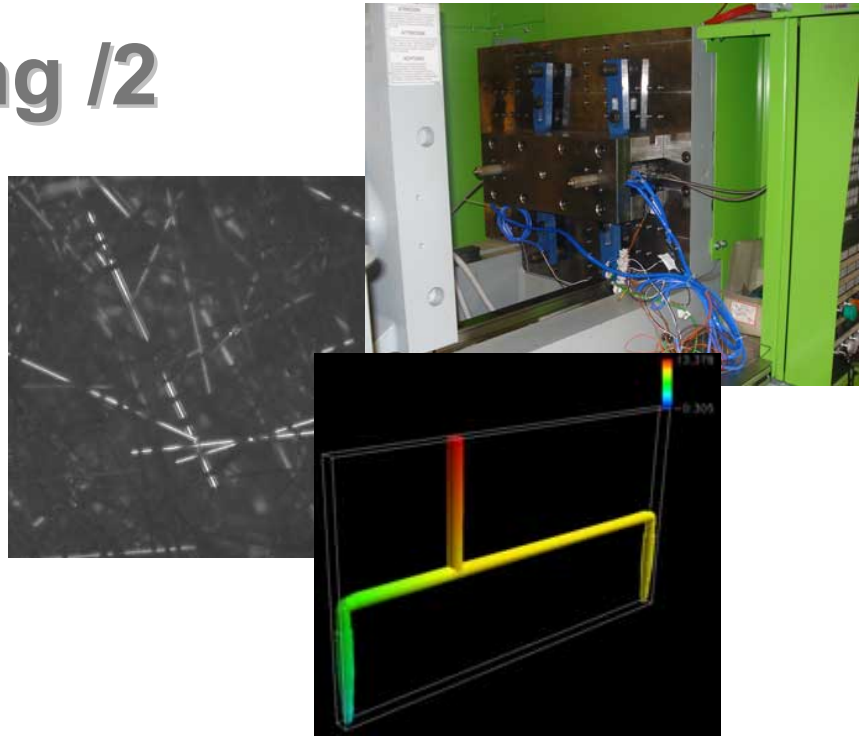
Micro Injection Molding

Processing of nanocomposite materials in micro-injection molding process.
Implementation of visco-elastic rheological models in numerical simulations
Development of new technologies for flow rate measurement in micro fluidics systems
Mold design and implementation of new technologies for process monitoring and control

Polymer Processing /2

Long Glass Fiber Reinforced Thermoplastic

Plastication screw shape optimization.
Analysis of the effect of nano-additives on the degradation of long glass fiber during the injection molding process.
Analisys of new heating system for polymer melting (i.e. infrared or microwaves).



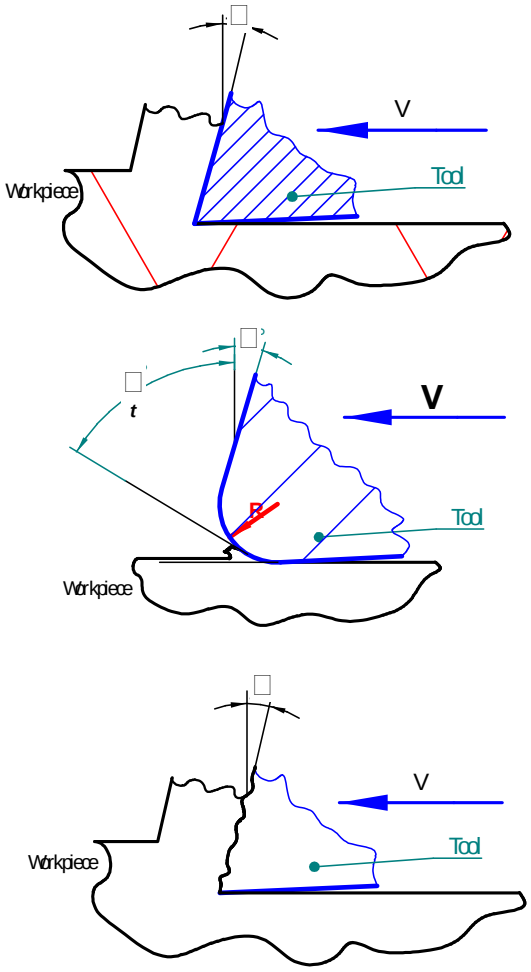
Bonded-magnet Polymer

Rheological characterization of bonded - magnet polymer using designed instruments and softwares.
Numerical simulations of injection molding process and determination of optimum process conditions.
Product Optimization.

Polymer Processing / Equipment

- All-electric injection moulding machine (Engel E-motion 440/100)
- Rotational rheometer (TA Instruments ARES)
- Modulated DSC (TA Instrument Q200)
- Twin-bore capillary rheometer (CEAST RHEO 2500)
- Universal testing machine with environmental chamber (MTS)
- Lab extruder (HAAKE PolyLab OS)
- Charpy pendulum (CEAST Resil Impactor)

Micro Machining / Modeling of Size Effects

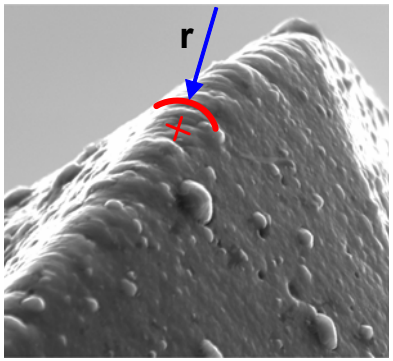


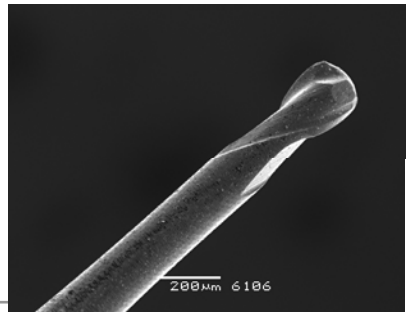
Size effects occur due to limited scalability of:

- Tool and workpiece material microstructure
- Tool geometry
- Tool surface topography

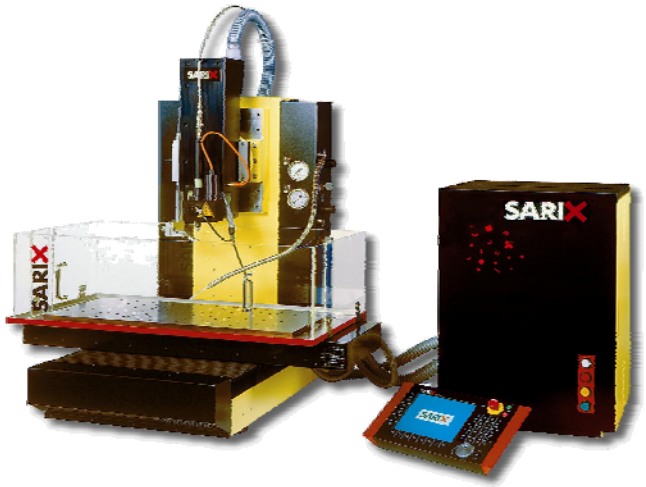
Consequences:

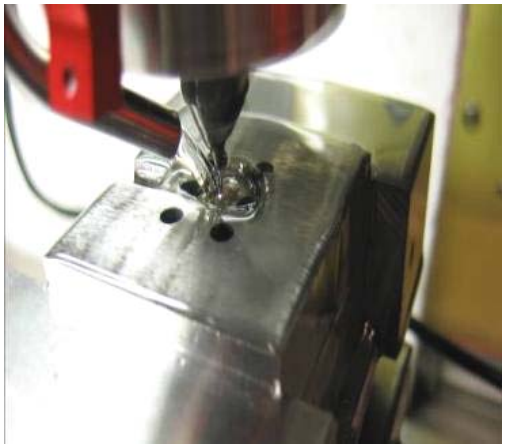
- Larger relative cutting forces
- Larger tool deflections
- Lower part accuracy
- Burr formation
- Part surface topography
- Risk of tool breakage

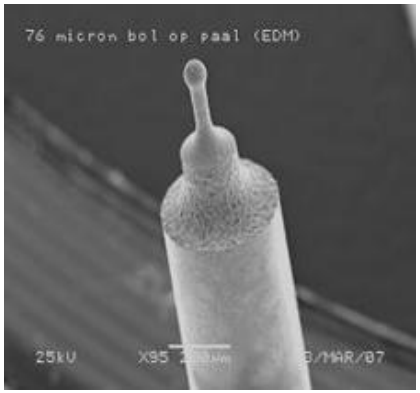




Micro Machining / EDM Milling

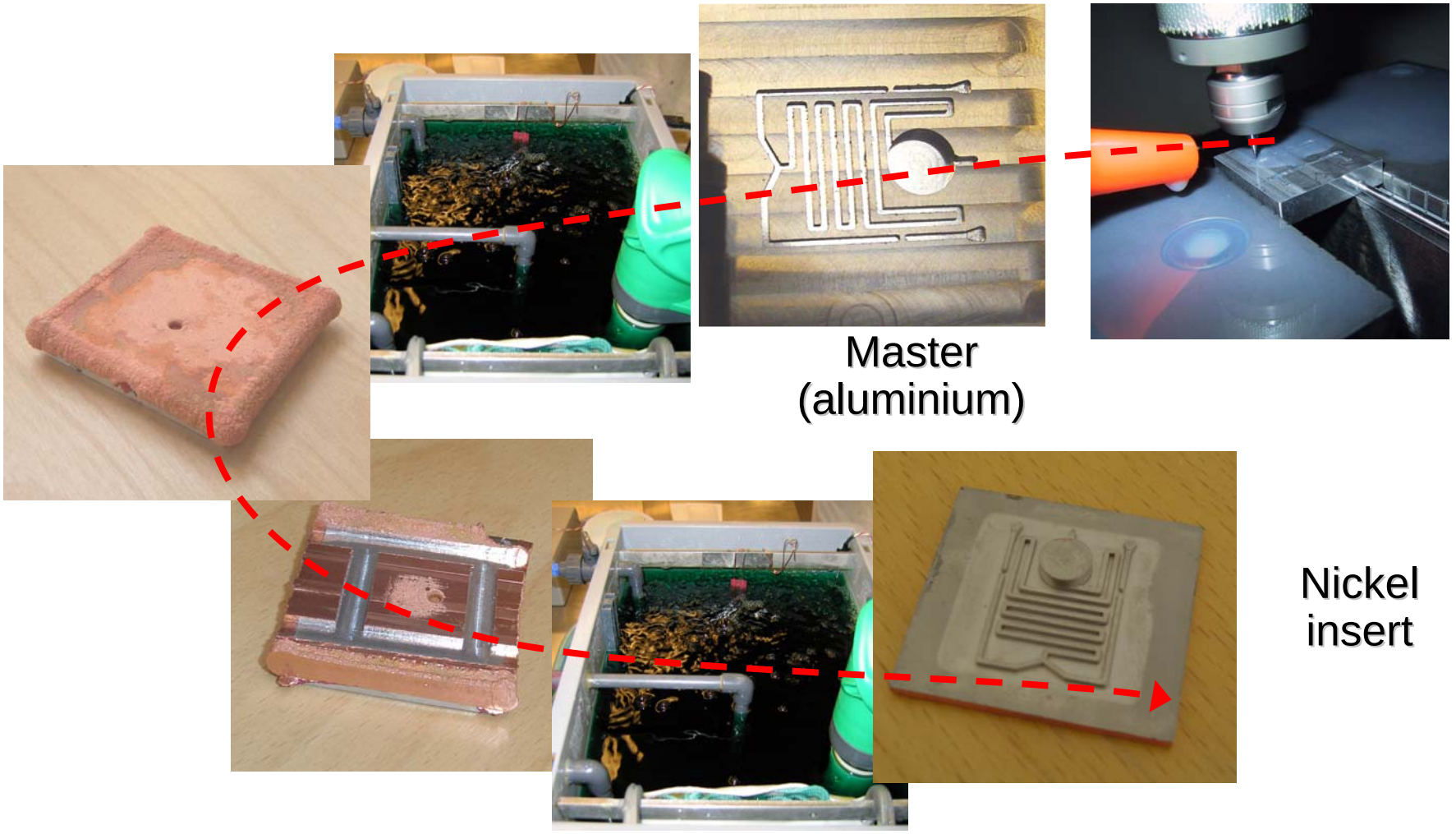






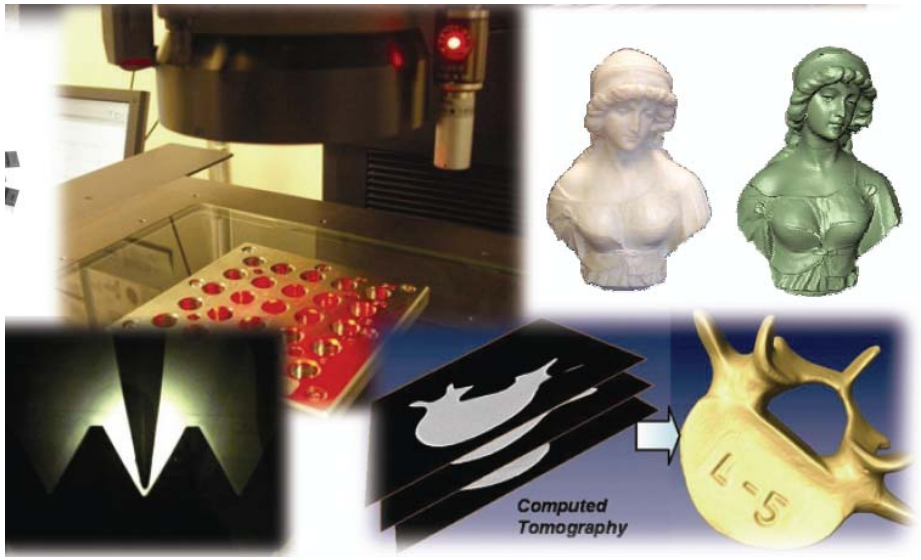
- Wear electrode prediction models
- Geometry prediction models
- In-process methods for the gap control

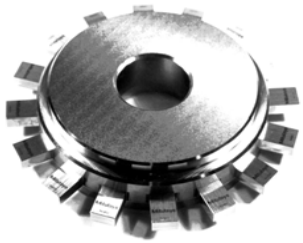
Micro Machining / tooling process chains

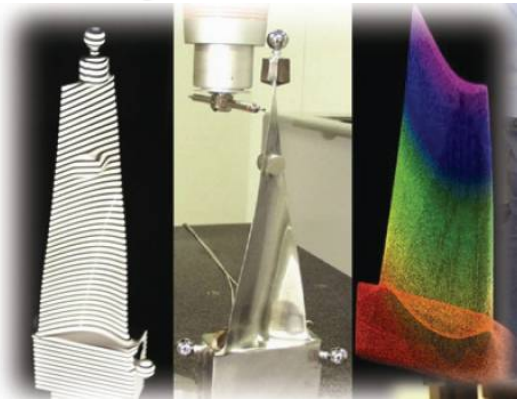


Industrial and Geometrical Metrology /1

Geometrical metrology
verification of complex tolerances
inspection of freeform parts
off-line programming and computer-aided simulation
gear metrology
quantification of surface texture



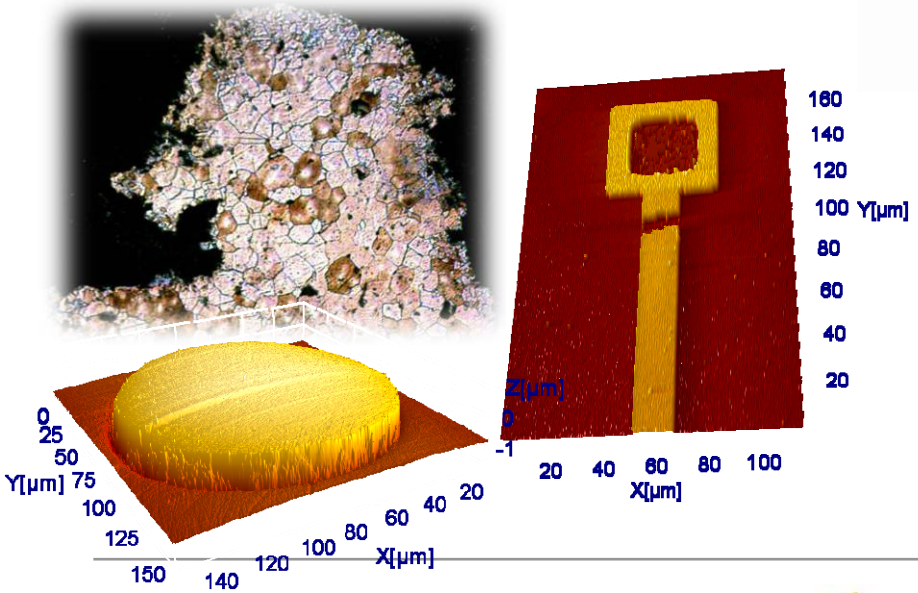




Digitisation and reverse engineering
digitisation of complex parts
CAD modelling (reverse engineering)
integration of optical and mechanical measuring systems

Industrial and Geometrical Metrology /2

Quality assurance for measuring and manufacturing systems
performance verification of CMMs
error mapping/calibration of CMMs
tesk-specific uncertainty assessment
calibration of roughness testers
verification tests for machine tools
process metrology for machining operations



Micro- and nano-metrology
Geometrical characterization of micro-parts
Atomic Force Microscopy, Scanning Electron Microscopy, Stylus Profilometry and Laser Scanner facilities
Silicon structures characterization

Metrology / Equipment

- multisensor measuring machine WERTH Video Check IP 400
- coordinate measuring machine ZEISS Prismo VAST 7
- digital roughness tester ZEISS-TSK Surfcom 1400A
- atomic force microscope (AFM) DME Dualscope 95-200
- strain measurement system CAMSYS ASAME Advanced
- digitisation system CAMSYS Shadowbox