OCAS

R&D topics

R&D topics - Metallurgy (1)

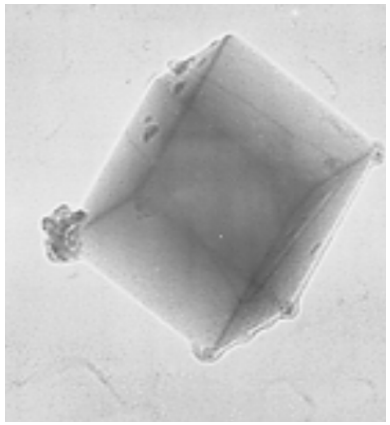
- Steel grades for mechanical construction
  - Pearlitic-bainitic-martensitic multi-phase steels
  - Steel grades for high temperature applications
  - Weathering & fire resistant steels
- Steel for energy pipes and heavy plates
  - Development of ultra high strength product range
  - Optimisation of heavy plate metallurgy for wide range of applications
  - Improving embrittlement resistance of steels
  - Optimising hydrogen induced cracking corrosion (HIC) properties

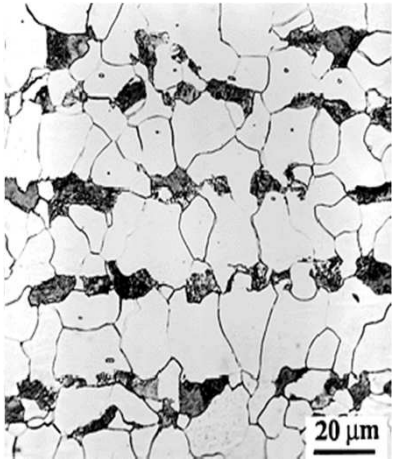
R&D topics - Metallurgy (2)

- Electrical steel grades
  - Fully processed (high permeability, low loss)
  - Grain-oriented electrical steel grades
  - Electro-magnetic shielding
  - Semi-processed (high permeability, low loss)
  - Coatings for electrical steels
  - Amorphous alloys
- Enamelling steel grades
  - Steels for direct white enamelling
  - Surface pre-treatment for enamelling
  - High strength steels for enamelling

R&D topics - Metallurgy (3)

- Basic research
  - Precipitation
  - Phase transformation
  - Damage
  - Texture control
  - Modelling
  - Hydrogen





R&D topics – Surfaces (1)

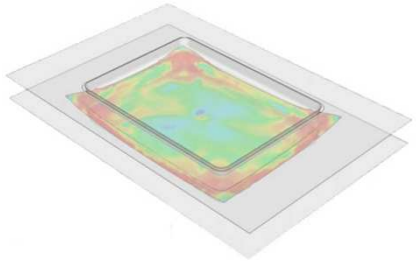
- Passivation coatings
  - Cr-free temporary protection / thin organic coating
  - Universal substrate for organic layer deposition
  - Dry lubricating protection suitable for direct painting
- New functional coatings
  - Steel with easy / self cleaning properties
  - Aesthetic and reflective surfaces
- Coating process development
  - Chemical vapour deposition
  - Thin organic / hybrid coatings
- Metallic coatings
  - Mg in metallic coatings
  - Exogenous particles in coatings
  - Electrolytic (co-)deposition

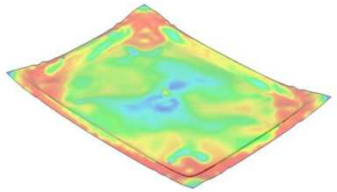
R&D topics – Surfaces (2)

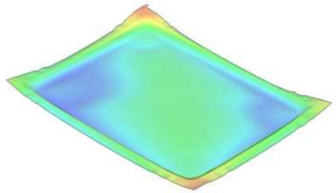
- Appliance
  - Conductive easyfilm: shielding, anti-static, grounding
  - Corrosion resistance
  - New concept for enamelling
  - Material selection for laundry dryers
- Metal processing
  - Ready-to-paint: synthetic oxide on hot rolled surfaces
- Construction
  - ZnAlMg coated steel
  - UV-primed steel

R&D topics – Applications & Solutions (1)

- Concept and solution development using new products
  - Problem-solving
  - Co-design
  - Co-engineering
    - Feasibility
    - Cost calculation
    - Simulations
    - Prototypes
- Applied research
    - New solution concepts
    - Deployment kits

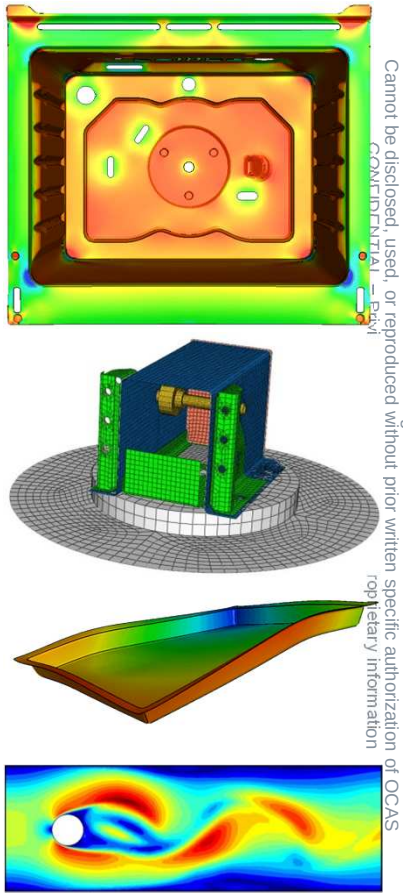






R&D topics – Applications & Solutions (2)

- Numerical simulation
  - AutoForm® (process definition, sensitivity analysis)
  - Prediction of gloss loss of pre-painted steel due to forming
  - SIMULIA / ABAQUS®
    - Stiffness, crash / drop test analysis, buckling
    - Clinching, vibration (modal analysis), etc.
  - FE-Fatigue® (nCode)
    - Fatigue (coupled with work hardening effects after forming)
  - COMSOL® Multi-physics (heat transfer)
  - Flux® 2D for magnetic modelling
  - CAD: NX-4 (I-Deas® / Catia®)



R&D topics – Product Safety

- Air analysis
  - Welding fumes and risk assessment
  - Volatile organic substances (VOC)
  - Volatiles emission from coated panels (Indoor Air Quality)
  - Release of thermal degradation compounds
- Nano-particle analysis (sampling and characterisation)
  - Real-time particle size distribution and concentration measurement
- Release into soil and water
  - Leaching test, extraction
  - Lixiviation of metals (Cr VI)
- Providing data
  - REACH compliant
  - As input for material data safety sheets (MSDS)

R&D topics – Cross sector contribution

- Acting as subcontractor for other ArcelorMittal sectors, such as stainless steel, wire solutions, long products, etc.
  - Services and technical support to production plants and research centres
  - Ensuring cross sector synergies

R&D service offer

- Training and knowledge transfer
- Applied research for problem-solving and co-engineering
  - Numerical modelling
  - Process simulations
  - Metallurgical processing including tailor made alloys and rolled sheet
  - Rapid prototyping and small series
  - Materials characterisation
  - Reporting and recommendations
- Fundamental research

R&D service offer

- Problem-solving

  Technical support for problems related to

  - Welding, mechanical joining and adhesive bonding
  - Cutting and punching
  - Deep drawing and bending
  - Enamelling
  - Galvanising
  - Organic coating and pre-treatment

- Co-design and co-engineering
  - Global design and cost optimisation
  - Vibro-acoustic measurements
  - Thermal related design
  - Forming, fatigue and joining simulations
  - Optimised use of electrical steel
  - Optimised use of enamelling grades
  - Gloss and appearance measurement

R&D service offer

- Metallurgical processing of tailor made alloys and rolled sheet

- Research partnership
  - Sharing our expertise for your R&D projects
  - **Commitment** to and **partnership** with your team in full **confidentiality**
  - Direct access to **experts** and cutting-edge **instruments**
  - Support by international network of engineering schools and universities
  - Increase materials innovation capacity
  - Think outside the box for your next generation developments

R&D service offer

- Forming
  - Deformation (stamping and crash) and heat transfer
  - Deformation (stamping and spring back) and electro-magnetic modelling
  - FEM simulations or conventional calculations on strength, stiffness, stability
  - Deformation properties of steel (bending / deep drawing)
  - Deformation analysis (strain analysis) / friction behaviour in stamping
  - Roughness & waviness (paint appearance pre & post paint)
- Mechanical properties of steel
  - High temperature (mechanical) properties
  - Fatigue
  - Fracture analysis
- Microstructure
- Chemical analysis
- Electro-magnetic properties of electrical steels, incl. modelling of electro-magnetic machines by FEM

R&D service offer

- Joining
  - welding and (thermal) cutting related topics
  - analysis of welding fumes
  - application behaviour welds
  - defectology of welds
  - mechanical joining, including clinching
- Vibro-acoustic behaviour
- Analysis of multi-material solutions (sandwich structures, joining, etc.)
- Cost calculations : steel sheet components & processes (for internal use only)
- Product safety
  - welding fumes (dust and gas) and risk assessment
  - lixiviation of metals (Cr^{6+}) for safety and food compatibility
  - volatile organic substances (VOC)
  - indoor air quality
  - Nano particles analysis

R&D service offer

- Coating
  - defectology on coated material
  - phosphate and E-coat related problems
  - painting and enamelling simulation
  - adhesion of metallic and organic coatings
  - application behaviour of coatings
  - chemical and surface characterisation of coatings and pre-treatments
- Surface characteristics of uncoated steels
- Adhesive bonding
  - application behaviour
  - characterisation of strength
  - compatibility with surface treatments
  - ageing behaviour
- Corrosion
- Electrochemical issues