New coatings and surface treatments

research lines

Instituto de Tecnología Cerámica

The Instituto de Tecnología Cerámica (ITC) is a concerted mixed Institute, established by agreement between the Ceramic Industry Research Association (AICE) and Universitat Jaume I of Castellón, which originated in 1969 in response to the needs of companies from the Spanish ceramic cluster. During its more than 40-year history, ITC has articulated a successful university–business cooperation system that has borne its fruits, witness the significant development of the Spanish ceramic tile manufacturing industry.

ITC is committed to providing solid support for Spanish ceramic companies in the defence and enhancement of their strategic positioning in the current global context, principally through innovation-enabling research and development actions, but also through whatever activities might serve to foster the competitiveness and growth of the sector, always based on sustainability criteria and commitment to societal well-being.

ITC's mission is focused on spearheading technology innovation and design processes in the Spanish ceramic sector, anticipating market and consumer needs regarding the uses and applications of ceramic materials, through professionalised management of a qualified human team committed to excellence in the sector.

The competence attained through ITC's wide-ranging research activity enables ITC today to extend its field of action to other types of processes and materials. Particularly noteworthy have been ITC's actions in the field of energy efficiency and the minimisation of industry's environmental impact, as well as in the functionalisation of ceramic surfaces and the achievement of new technical performance and aesthetic features of products related to the habitat hyper-sector and to other industries, such as the high-tech tool, advanced ceramics, automotive, petrochemical sectors, etc.

new coatings and surface treatments

The work conducted by ITC in the field of traditional ceramic materials has demonstrated that the use of certain coatings can provide these materials with properties that enhance their response to external conditions. ITC research into glaze coatings has focused on improving mechanical, physical, and chemical surface characteristics and on providing the surface with special aesthetic properties.

Particularly to be noted is the research conducted into the development of coatings with enhanced mechanical properties, such as microhardness, modulus of elasticity, and toughness. These studies have provided a thorough understanding of surface abrasion mechanisms and tribological performance. Furthermore, numerous studies have been carried out to establish the relationship between coating microstructure and mechanical properties.

At present, in addition to the foregoing studies, ITC is working in the coatings field on new research lines:

OVER 1000 R&D PROJECTS DEVELOPED THROUGHOUT THE HISTORY OF ITC, AMOUNTING TO ALMOST 40 MILLION EUROS.

The use of nanoparticles for the obtainment of coatings with properties hitherto unobtainable by traditional systems.

The application of multiple, very thin layers (in the nanometre range) for the obtainment of structures that have unique physical and mechanical properties, not to be found by themselves.

The use of nanostructured coatings on the ceramic tile surface, which enhance slip resistance, stain resistance, and cleanability without impairing surface aesthetic qualities. In this line of work, to be noted are the photocatalytic coatings that, in the presence of ultraviolet light, oxidise organic matter in contact with the surface, thus providing the surface with self-cleaning properties, or the photovoltaic coatings that are able to generate electric energy from sunlight.

Superhydrophobic glaze, with a mechanism resembling that of a lotus leaf.

ITC IS A REFERENCE PARTNER IN DIFFERENT NATIONAL AND INTERNATIONAL NETWORKS AND TECHNOLOGY PLATFORMS.

The NANOCIT consortium project, aimed at exploring the potential scope of the carbon nanotubes used as fillers in resins. The studied features include the mechanical and electric properties of the resulting coatings, which are applicable to ceramic tiles.

The development of new (organic/inorganic) hybrid materials applied as coatings on to construction materials (stone, timber, ceramics, and plastics), which enhance materials wear and scratch resistance, while also providing new functionalities.

In this context, by hybrid materials are meant materials made up of polymer chains of an organic and inorganic nature, which are intimately polymerised, with the presence of covalent bonds between chains of different nature. This type of synthesis enables properties such as hardness (typical of ceramic materials) and deformability (typical of polymer materials) to be obtained.

At present, in this line of work, ITC is coordinating a two-year research project in the RENAC network, funded by IMPIVA and the European Regional Development Fund (ERDF), which it is intended to pursue further in subsequent studies.

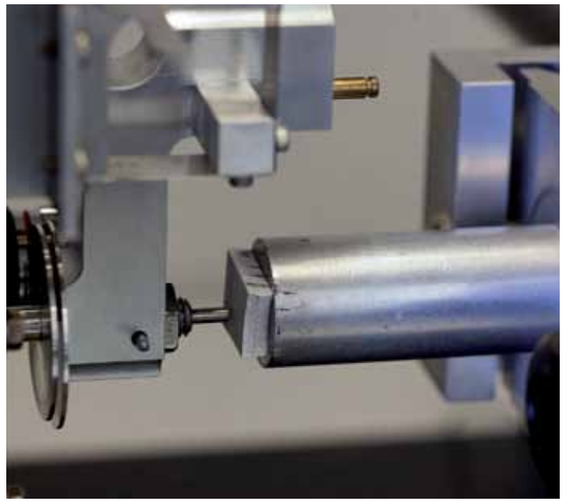
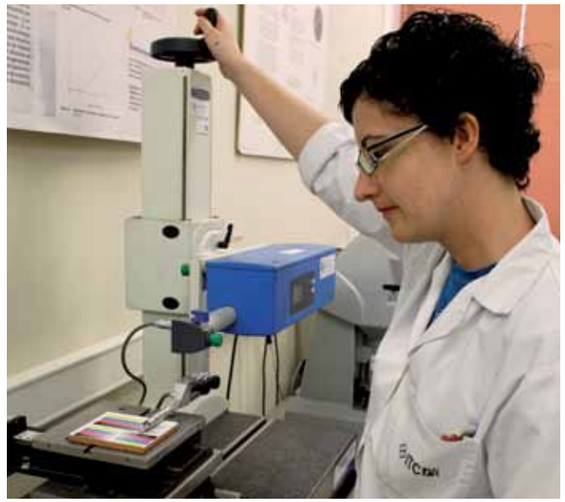
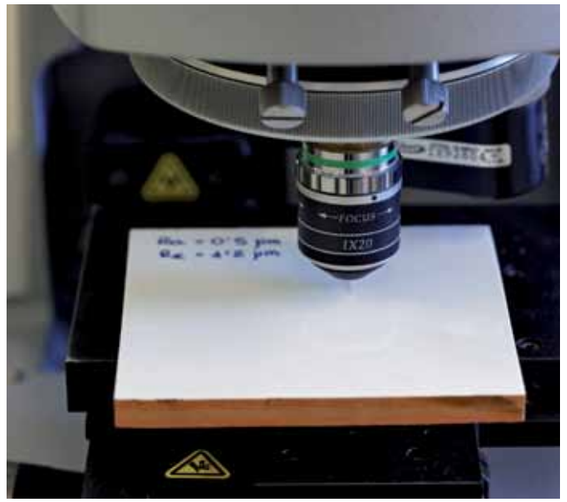
The development of coatings of composite materials of a ceramic nature, which are combined with polymer matrices.

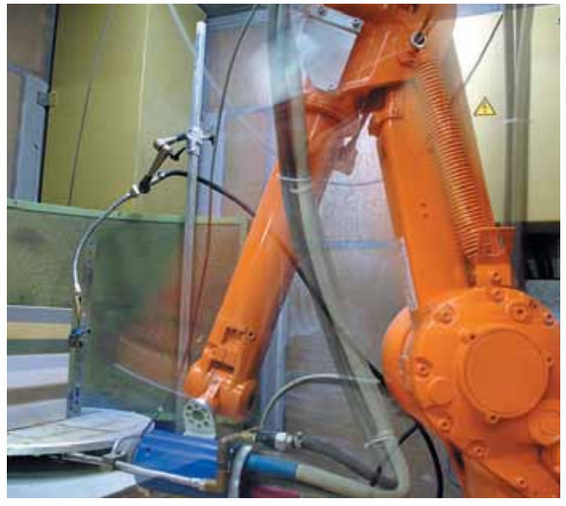
On the other hand, the application of nanoparticle-containing coatings requires the incorporation of new nanoparticle deposition techniques. Thus, ITC is currently working together with other Institutes on various application techniques, such as PVD, thermal plasma spraying, electrostatic deposition, tape casting, etc., which enable layers with a wide range of thickness (from just a few to hundreds of micrometres) to be obtained with a nanocrystalline structure that provides interesting technical and aesthetic properties: coatings of nanometric thickness with a metallic appearance, ceramic coatings with optical interference colours, etc.

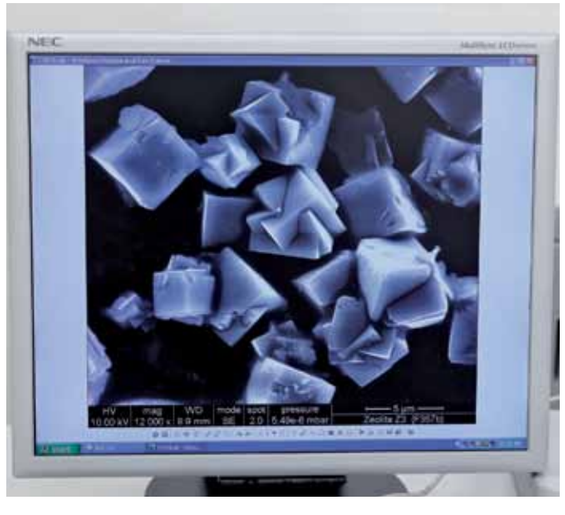
The application of these deposition techniques for nanomaterials is not just limited to ceramic tiles: ITC is currently exploring the application of these coatings with a view to improving the properties and service performance of a wide range of components used in traditional manufacturing branches (metal mechanics, mining, textile, glass, etc.) and high-tech industries (automotive, aerospace, defence, etc.).

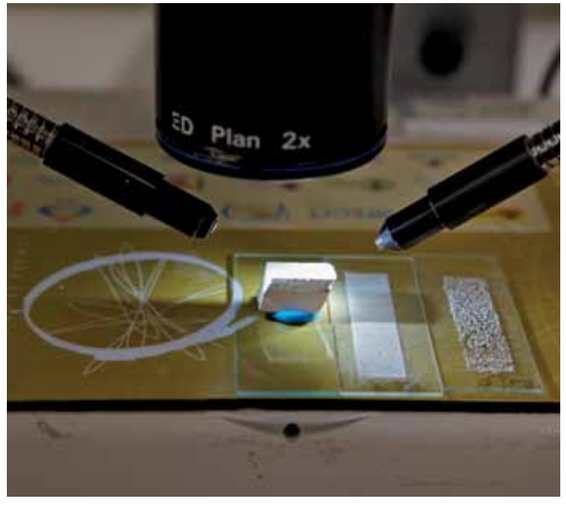
available equipment

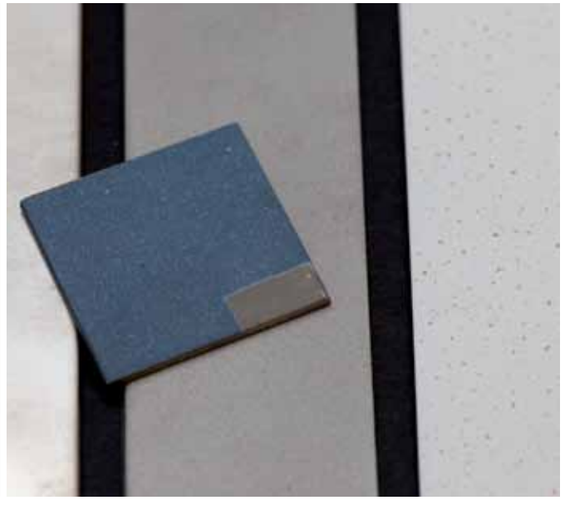
ITC sets at the disposal of companies a great technological infrastructure of technical competence endorsed by both ITC's high number of external accreditations and its highly qualified human and instrumental resources, which assure total reliability with regard to the results obtained in the characterisation of raw materials and end products, and in the determination of their behaviour during the production process.









ITC CURRENTLY HAS
TECHNICAL AND SCIENTIFIC EQUIPMENT
FOR CONDUCTING
R&D VALUED AT
OVER 9 MILLION EUROS.

- Thermal plasma spray equipment. SULZER METCO (F4 MB gun) handled by an ABB IRB 1400 industrial robot.
- HOMMELWERKE T8000 roughness meter.
- WYCO NT 1100 optical profiler.
- Tape casting (thin-film application equipment).
- XPS/ESCA. X-ray photoelectron spectroscopy for nanometre-scale surface chemical analysis. SPECS SAGE 150 instrument.
- Glossmeter. Statistical Novo-Gloss, Rhopoint Instruments.
- PHILIPS XL30 scanning electron microscope (SEM).
- Nanotest (nano-indentation, scratching, wear, impact, pin on disk).
- Tribometers (Gabrielli and Taber abrasion testers, Calotest, pin-on-disk tribometer).

IN THE COURSE OF ITS 40-YEAR HISTORY, ITC HAS CARRIED OUT ABOUT **150,000 ANALYSES AND TESTS** OF THE MORE THAN **475 DIFFERENT TYPES** THAT IT CURRENTLY OFFERS.

technical references

ITC has the capability to transfer the knowledge acquired through the ongoing training of its team of qualified human resources, who keep their knowledge up to date by conducting various R&D&I actions and studies, in addition to participating in numerous science and technology forums worldwide and in different international platforms and consortia. This knowledge, together with that acquired or assimilated from other production sectors, serves to generate the innovation that is transmitted to the companies, which need this to maintain or to enhance their competitiveness.

R&D&I projects co-financed with public funding

European Commission

KMM-NoE 502243-2 - Knowledge-based Multicomponent Materials for Durable and Safe Performance, (2004-2007).

BRE-20469 - Measurement of surface hardness of ceramic tiles by Vickers indentation method, (1995-1999).

BE-5167-92 - Advanced Dry Glazes and Dry Glazing Technologies for Traditional Ceramics, (Floor and Wall Tile) (1993-1995).

CR-1001-1-91- Obtaining Smooth Ceramic Glazes with Improved Wear Resistance and Hardness, (1993-1995).

Central Administration

IAP-600100-2008-26 – Design of materials with high added value based on the dispersion, deposition and/or funcionalisation of carbon nanostructures (2008-2010).

CIT-420000-2008-2 – Obtainment of coatings by air plasma spray from reconstituted nanostructured powders (2008-2009).

MAT2006-12945-C03-01 – Development and properties of high-performance nanostructured coatings (2006-2009).

FIT-380000-2004-118 – Obtainment of eco-coatings with optimised mechanical properties (2004-2005).

FIT-380000-2004-117 – Development of roofing tiles with low bioreceptivity; proposal of an accelerated method of evaluating resistance to biological colonisation (2004-2005).

Regional Administration

IMCOCA/2006/28 – Development of advanced hybrid construction materials with optimised tribological properties, (2006-2007).

IMCITA/2005/2 - IMCOCA/2006/1 Development of a high-performance coatings technology that can be transferred to the Valencian ceramic sector, IMPIVA (2005-2006).

IMAETA/2004/14 – Thin-film technology with nanometric materials (2004-2007).

IIARC0/2004/307 – Network for the application of nanotechnologies in materials and products for construction and the habitat, (2004-2005).

IMIDIC/2004/1 – Use of plasma spraying in the development of new applications on ceramic materials (2004-2005).

IMIDIC/2003/25 – Development and optimisation of ceramic coatings applied by thermal spraying (2003).

IMTEFB/2000/39 IMDIC/2001/7 – Study of the effect of ceramic tile manufacturing process variables on the variability of matt glaze gloss (texture) (2000-2001).

THE DISSEMINATION OF THE RESULTS OF THE STUDIES CONDUCTED BY ITC FROM THE OUTSET HAS LED TO 600 PUBLICATIONS OF SCIENTIFIC ARTICLES IN SPECIALISED JOURNALS, 700 COMMUNICATIONS AT NATIONAL AND INTERNATIONAL CONFERENCES, AS WELL AS THE DEVELOPMENT OF 31 PATENTS.

Related patents

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SALVADOR, M.D.; AMIGÓ, V.; SEGOVIA, F.; CANDEL, J.; BONACHE, V.; SÁNCHEZ, E.; CANTAVELLA, V. Comportamiento al desgaste de recubrimientos de WC proyectados por plasma a partir de polvos micro y nanoestructurados. *Rev. Metal. Madrid,* 44 (3), 222-232, 2008.

MORGIEL, J.; SÁNCHEZ, E.; GRZONKA, J.; BANNIER, E.; VICENT, M.; MAJOR. L. The microstructure of WC-12%Co plasma sprayed coatings obtained from micro- and nano-powders. *Inzynieria Mater.,* ROK XXVIII, 1-6, 2007.

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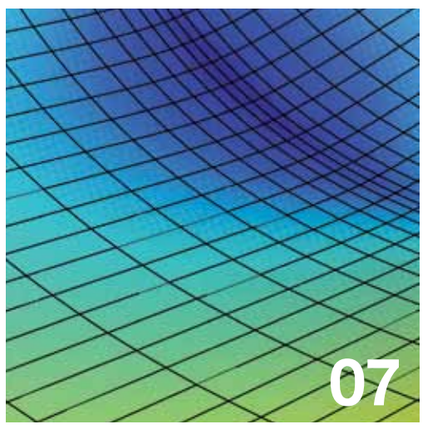

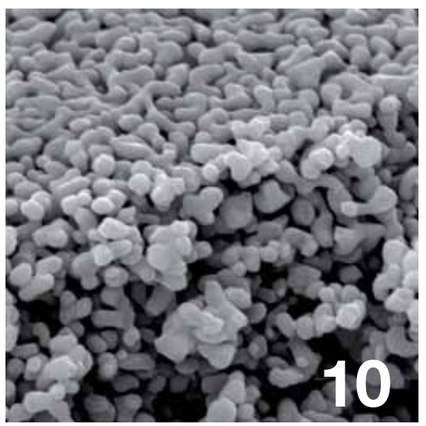

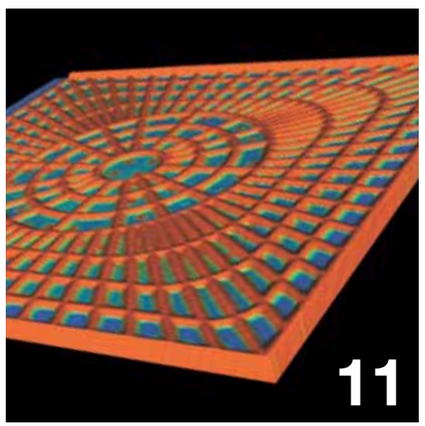

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