



## Thematic Actions

### Coordinating Universities for the Proposal: UCM and UPM

<b>Title of Action</b>	<b>Mechanical Properties Workshop: Durability and Sustainability of Materials</b>		
<b>Participating partners</b>	UPM, IMDEA-Materials, UCM, CENIM	<b>Other participants</b>	
<b>Personnel involved (indicate institution)</b>	J. Llorca (UPM), J. Gálvez (UPM), J. Rojo (UCM), J. Pérez Trujillo (UCM), O. Ruano (CENIM)		
<b>Start date</b>	2010	<b>End date</b>	
<b>Cluster</b>	Materials for the Future	<b>Other clusters</b>	Global Change and New Energies
<b>Areas of action</b>	Research / Knowledge Transfer / Teaching Improvement and EHEA Deployment		
<b>Location</b>	Moncloa Campus		
<b>Infrastructures involved</b>	Advanced Microscopy, ISOM		
<b>Keywords</b>	Mechanical properties; Composites; Alloys; Surfaces; Simulation; Characterisation		
<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>- Research, technology development and advanced education in the field of the mechanical properties of materials, mainly focused on the macro and mesoscopic ranges, with special emphasis on surface behaviour. In particular, the aim is to carry out work into the characterisation, modelling and, whenever feasible, the advanced design of composites, alloys and compounds of special interest today, such as ceramics and polymers. Although the main focus will be on structural materials and on the study of the evolution in building materials, such as cement bases, metals, ceramics, fibre and resins, certain functional materials will also be assessed.</li> <li>- Scientific and technical improvements in the knowledge of the life cycles of building materials, as a contribution to sustainable development through a reduction in energy consumption during their production, manufacturing and application stages, as well as increasing environmental awareness.</li> <li>- Use of building materials sourced from recycling other materials and urban waste.</li> <li>- Comprehensive study of the life cycle of materials (from raw materials throughout fabrication, use, repair, disposal and recycling), focusing on CO<sub>2</sub> generation and absorption issues and energy consumption.</li> </ul>			
<p><b>Description of the action:</b></p> <p>The emphasis will be on a multidisciplinary approach. The proposed consortium combines the individual work of chemists, physicists and engineers based at the Moncloa Campus and exploits existing contacts with companies. The proposed action is not a simple statement of intention, in fact the research groups of the various institutions involved are fully consolidated teams with a vast experience and a large scientific output, hence their cooperation in specific projects entails a high added value.</p> <p>In the field of mechanical properties, the recently created IMDEA-Materials Institute is a key element for the proposed action, given that one of the Institute's main objectives is the study of the mechanical properties of materials. The input from this Institute may be complemented, in the field of metallurgy, by research teams at the CENIM Institute-CSIC and at the UCM Faculty of Chemistry, which have been carrying out important work in the field of metal alloys for some years. In addition to this, the existence of a Surface Physics group at UCM with a recent line of research into the mechanical properties of surfaces (both under experimental and simulated conditions), covers this particular area efficiently.</p> <p>Special attention will be paid to the long-term performance of concrete with a high content of waste or recycled material, and to the evolution of its properties and durability in urban environments (high CO<sub>2</sub> contents), assessing the full life cycle in terms of environmental impact and sustainability. In order to develop green technologies, model plants will be designed to perform tests under aggressive environments (pollutants, reactants, pressure, and temperature).</p>			



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<p><b>Key planned results:</b></p> <ul style="list-style-type: none"><li>• Scientific papers in prestigious physics, chemistry, engineering and, in particular, materials science journals.</li><li>• Contracts with companies for projects on the mechanical properties of materials.</li><li>• Obtaining public European (Framework Programme), Spanish (National Plan), regional and local funding.</li></ul>	
<p><b>Rationale for the action:</b></p> <p>For many years now there have been research groups at both universities (UPM and UCM) highly active in this field. Recently, they have been joined by a newcomer – the IMDEA-Materials Centre – that derives from one of these groups. The combined capabilities of all these agents are complementary, and several synergies are likely to arise in: (a) research (b) technology transfer (c) higher education (MSc and PhD programmes). Said capabilities include scientific infrastructures (more focused in macroscopic parameters at UPM and CENIM, more devoted to meso and macroscopic studies at UCM) and a valuable workforce.</p> <p>A key question to be addressed is the reduction in natural raw material consumption, energy and the CO<sub>2</sub> footprint. All issues related to the long-term behaviour of these materials (over timeframes of tens of years) are presently under study. Some critical aspects are the study of microstructure, the generation of hydration by-products and their evolution over the years.</p>	
<p><b>International aspects:</b></p> <p>All intervening groups exhibit ample international relations, which could be strengthened and shared, including the following partnerships: IMDEA: MIT, Ruhr-Universität, Bochum; UPM: Northwestern University; UCM Physics: University of Berkeley, Max Planck Berlin. In addition to this, Prof. Jaime Gálvez (UPM) is a consultant for IECA on these subjects in European Certification bodies.</p>	
<p><b>Planned impact:</b></p> <p>Future of the research: a multidisciplinary analysis of all issues, including engineering, particularly suitable for the design of materials with tailored mechanical properties.</p> <p>Moncloa Campus integration.</p> <p>Campus specialisation: the mechanical properties of materials are a key aspect in structural materials. The Moncloa Campus has unique, proven and acknowledged capabilities in this field.</p> <p>The excellence in teaching, research, technology transfer and international relations of the candidate groups has already been proven. Exchanging these strengths will ensure that the actions carried out are complementary and will achieve higher rates of excellence in the process.</p>	
<p><b>Other institutions interested:</b></p> <p>Companies and public bodies dealing with building materials. In particular, the UPM group works in these matters with the Spanish Institute of Cement and its Applications (IECA), several civil engineering companies and the Iron &amp; Steel Industry Quality, the Centre for Industrial Automation (CSIC) and the INTEMAC Company, specialised in structure monitoring and auscultation surveys.</p>	