

## R&D COLLABORATIVE PROPOSAL / COMPANY PARTNER SEARCH

The information you are about to provide in this form will be distributed among Spanish companies matching your company profile and that might be interested in the proposal of collaborative R&D project that you will be describing in this form. (Please use English language for filling in the document)

In the case that your company will establish a R&D project in collaboration with a Spanish company, you could present a Joint Project Proposal to the CHINEKA Program.

### YOUR ENTITY PROFILE

**Name:** IMDEA Materials Institute

**Number of employees:** 120

**Annual turnover:**

**Balance Total:**

**Year of latest financial report:** 2019

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**City:** Getafe

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**Contact:** Prof.Dr. De-Yi Wang

**Position:** Head of the High Performance Polymer Nanocomposites Group

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## COLLABORATIVE R&D PROJECT PROPOSAL

(Describe as precisely as possible the technology cooperation proposal. Describe what you have to offer and what you expect from your potential partner) Include: Sector Group; Abstract of Project; Innovations Offered; and Current State of Development

<b>Title</b>	Natural-based minerals as high value-added green additives to polymer-based materials for improving flame retardancy and mechanical properties <b>(NAMINA)</b>		
<b>Duration (YM- YM)</b>	09/2022-09/2024		
<b>Budget(1,000 Euro)</b>	SPAIN	CHINA	TOTAL
<b>Technology Field</b> (Click a box)	<input type="checkbox"/> Smart Cities <input checked="" type="checkbox"/> Production Technologies, <input type="checkbox"/> Biomedicine and Technologies for Health, <input type="checkbox"/> Environment technologies <input type="checkbox"/> Clean Technologies <input type="checkbox"/> Modern Agriculture <input checked="" type="checkbox"/> Advanced Materials. <input type="checkbox"/> Others		
<b>Summary</b>	<p>Minerals as natural based source, such as <b>atapuigate</b>, <b>zeolite</b>, wollastonite, <b>bentonite</b>, vermiculite, kaolin, <b>brucite</b>, <b>talc</b>, etc., are abundant in the worldwide. However, the distribution of these minerals is quite different at varied areas and/or countries. Since last century, more and more people realized the importance of these natural-based minerals and started to use them in the difference areas. At present, plenty of these minerals have been applied in the industrial sectors, such as cat litters, ceramics, additives, petroleum production process, etc. However, most of the current application of these minerals are still in these traditional applications as low-value utilization. Indeed, the intrinsic values of these minerals are not fully developed due to the lack of new technology and innovative approach. In other word, these minerals have plenty of potential values which need to be further developed in order to increase their value-added as compared to the current simplified application.</p> <p>Polymer-based materials have been widely used in the industrial sectors, such as electrical&amp;electronic, building, cables, pipes, coating, aeronautic, etc. However, the properties of most polymers need to be enhanced by introducing different functional additives, such as the improvement of thermal stability, or mechanical properties, or flame retardancy, etc. In this context, the functional fillers play the key roles. Prof.Dr.De-Yi Wang who is the technical leader/coordinator in this consortium focuses on high performance eco-friendly flame retardants by functionalized fillers in the past 20 years, have established widely collaborative networks in the materials industrial in the worldwide. By carefully considering the potential values of natural based minerals, state of the art functionalized technology to fillers, and the potential marketing in China, in this project we propose "Natural-based minerals as high value-added additives to polymer-based materials for advanced application." Definitely, <b>the main targets of this project are to improve the value-added of the mineral-based products in advanced application via innovative technology, international collaboration and marketing oriented.</b></p> <p>The research contents in this Project include: Surface functionalization of mineral fillers, optimization of formulation, polymer</p>		

processing, structure-properties relationship, trails in marketing oriented. These takes Will rely on close collaborations between two teams from Spain and China.

In this project, the consortims will include two teams from Spain and China. In details, it is expected that: from Spanish side, one industrial parter from Spain (prefer to minerals related or composites related /or manufacturing company), and one research/technology center (IMDEA Materials as technology developer) will be included; From Chinese side, one top industrial company which is close to the relevant markets (cables, pipes, construction, coating, etc.) and one University (be charge of supporting some technological development to industrial partner in China) will be involved.

## SPANISH PARTNERS

(When you know a potential Spanish company, write its name and contact details in this section) Please, make a description of the desire type of Spanish Technology Partner.

### Keywords:

Minerals; fillers; manufacturing; natural additives; polymer composites; inorganic filler; fire retardancy; reinforcement; composites;

-We are looking for suitable industrial partner from Spain which are interested in developing new technology, increase the value-added of the products (e.g. natural based minerals) and enlarge the international markets for some advanced application to the current products.

## YOUR ENTITY DESCRIPTION

(Entity Website, Research and development guidelines, strategic alliances, competitive position, etc)

IMDEA Materials Institute (Spain)	
<p>General description</p>   <p>EXCELENCIA MARÍA DE MAEZTU</p>	<p>IMDEA Materials Institute (IMDEA), one of the seven Madrid Institutes for Advanced Studies, is a public research centre founded in 2007 by Madrid's regional government. The goal of the Institute is to do research at the forefront of Material Science and Engineering, attracting talent from all around the globe, and collaborating with companies in an effort to transfer fundamental and applied knowledge into valuable technology. The IMDEA Materials Institute has a established international reputation in the areas of design, processing, characterisation, modelling and simulation of advanced materials for applications in different industrial sectors with particular emphasis in transport, energy and health.</p> <p>Since the beginning of its activities in year 2007 IMDEA has been involved in more than 190 research projects (total budget € 18 million), funded by public bodies (EU framework programmes, AFOSR, RFSC, national agencies ...) and private companies. Amongst these, 58 are currently active and 15 are directly funded by industry (total budget € 1.2 million). Toyota motor Europe, HP printing solutions, ITP Aero, Airbus, TESA, Renisaw, Talgo, BASF, ANSYS, HEXCEL composites are amongst the companies IMDEA Materials has / is collaborating with.</p> <p>Around 120 people do research at the Institute, which is currently organised into sixteen research groups. The Institute received the 'HR Excellence in research' award on October 2015 and was recognized as a 'María de Maeztu' unit of excellence in October 2019 by the Spanish Ministry of Science, Innovation and Universities.</p>

<p><b>Role of key persons</b></p>	<p><b>Prof. Dr.De-Yi Wang</b> is a Senior Researcher and Program Leader of multifunctional nanomaterials for advanced application at IMDEA Materials Institute. He leads the research group of High-Performance Polymer Nanocomposites. The research group includes 5 postdoctoral researchers, 8 PhD students and 2 technicians. His research activities focus on new generation eco-friendly fire-retardant materials, high performance polymer-based composites, multifunctional nanomaterials, etc., which are mainly application-oriented research topics. He has proven experience in developing novel flame-retardant materials and high-performance polymer-based composites as shown by his publication records (over 190 peer-reviewed international journals and 20 invention patents registered) and by the participation of over 20 research programs as PI funded by European Commission, National government, and industrial sectors in the worldwide, such as TESCOM (European Commission), NEOADFOAM (Spanish Government funded), SEPIFIRE (Industrial Sector from Germany), NEWTOP (Industrial Sector from China), FRANK (Industrial Sector from Germany), FRCOAT (Industrial Sector from China), etc. In 2014, he was appointed as "IPF Fellow" in Germany. Currently, he is an PhD advisor and Adjunct Professor of Technical University of Madrid (UPM) in Spain. In 2016, he elected the Fellow of Royal Society of Chemistry (FRSC) in UK. In 2019, as one of the core proposers he established China-Spain Joint Research Center of Advance Materials (9 institutions were involved from China and Spain) and/or was appointed as the director of this joint center.</p>
<p><b>Research facilities and Equipment</b></p>	<p>IMDEA has state of the art facilities for study the fire-retardant materials and high-performance polymer-based composites. The most relevant for this project are:</p> <ul style="list-style-type: none"> <li>- Surface functionalization of fillers (e.g. minerals): high speed mixer, ball grinder, etc.</li> <li>- Polymer processing: twin-screw extruder, injection machine, inter mixer, hot press, triple roller mill, high speed mixer, etc.</li> <li>- Fire facilities: UL94 Horizontal/Vertical Flame Chamber, Limiting Oxygen Index, Dual Cone Calorimeter, simulated single burning item, microscale combustion calorimeter, thermal analysis coupled with FTIR and differential scanning calorimeter, etc.</li> <li>-Structural characterization: SEM, TEM, XRD, Raman, X-ray computer-assisted 3D nanotomography, FTIR, particle size analysis, GPC, etc.</li> <li>-Thermal and mechanical properties: TGA, DSC, DMA, Universal electromechanical testing machine, AFM, rheometer, impact tester, indentation, etc.</li> </ul>
<p><b>Relevant publications / patents / products</b></p>	<ol style="list-style-type: none"> <li>1. Xiao-Long Li, Fu-Hui Zhang, Rong-Kun Jian, Yuan-Fang, Jin-Lu, Guo-Jing Hui, De-Yi Wang. Influence of eco-friendly calcium gluconate on the intumescent flame-retardant epoxy resin: Flame retardancy, smoke suppression and mechanical properties. Composites Part B: Engineering, 2019, 176,107200.</li> <li>2. Pablo Acuña, Zhi Li, Mercedes Santiago-Calvo, Fernando Villafañe, Miguel Ángel Rodríguez-Perez, De-Yi Wang*. Influence of the Characteristics of Expandable Graphite on the Morphology, Thermal Properties, Fire Behaviour and Compression Performance of a Rigid Polyurethane Foam. Polymers, 2019, 11(1),</li> <li>3. . Yunxian Yang, Laia Haurie, Jianheng Wen, Shuidong Zhang, De-Yi Wang*. Effect of oxidized wood flour as functional filler on the mechanical, thermal and flame-retardant properties of polylactide biocomposites. Industrial Crops and Products, 2019, 130, 301-309.</li> <li>4. Zhi Li, Junhao Zhang, Francios Dufosse and De-Yi Wang*. Ultrafine nickel nanocatalyst-engineering organic layered double hydroxide towards super-efficiently fire-safe epoxy resin via interfacial catalysis. J. Mater. Chem. A, 2018, 6, 8488-8498.</li> <li>5. "Novel Fire Retardant Polymers and Composite Materials" Editor : De-Yi Wang. Date: 06 Sep 2016, Elsevier (Woodhead) Publishing, Print Book ISBN : 9780081009772</li> <li>6. De-Yi Wang, Nian-Jun Kang, Xiao-Min Zhao. A halogen free flame-retardant epoxy resin composition. International Patent Application, PCT 2917.3, 2013.</li> </ol>

Chinese Company 1 (China)	
<p><b>General description</b></p> 	<p>Chongqing Jiaotong University (CQJTU), as one of the higher education institutions in China, enjoys a nation-renowned reputation in transportation and civil engineering. As a key university directly under the administration of Chongqing Municipal Government, CQJTU has become a comprehensive, research/teaching-oriented and internationalized university with some 70 years' efforts.</p> <p>Up to now, CQJTU has 3 postdoctoral research stations, 4 first-level disciplines authorized to offer doctorate degree, 14 second-level disciplines authorized to offer doctorate degree, 16 first-level disciplines authorized to offer master degree, 54 second-level disciplines authorized to offer master degree and 5 disciplines authorized to offer professional master degree. CQJTU has 1 national engineering technology research centre, 1 national key laboratory, 1 national-local joint engineering laboratory, 35 provincial/ministerial key laboratories and 12 provincial/ministerial key disciplines. Currently, 32,114 students at different levels and in different fields, including 27,981 full-time students, study and search in CQJTU. At present, CQJTU has a faculty of 2,049, including 1,556 full-time teachers. Among the full-time teachers, nearly 120 people obtain provincial/ministerial (or above) professorship.</p> <p>CQJTU has established friendly, long-term cooperative relationships with more than 15 universities and scientific research institutes from United States, Russia, Canada, Germany, United Kingdom, France, Japan, Australia and Poland to carry out extensive academic exchange and research cooperation.</p> <p>CQJTU has successively undertaken multiple national and provincial/ministerial scientific research projects including the National Program for Tackling Key Problems in Science and Technology, "the State 863 Program", "the State 973 Program", the National Key Research and Development Project, projects under the National Social Science Foundation and key tackling programs in fields of philosophy and social sciences of the Ministry of Education. In 2019, the scientific research grant to the University was over CNY 252 million. Over past decade, CQJTU has won nearly 200 provincial/ministerial awards for the progress in science and technology, including the National Prize for Progress in Science and Technology (first, second and third prizes), the State Invention Award, the National Teaching Achievement Award and the China Bridge Award-the Grand Prize for Mao Yisheng Science and Technology Award.</p>
<p><b>Role of key persons</b></p>	<p>Dr. Zhi Li, Associate Professor of CQJTU, obtained the Doctoral Title (Cum Laude) concerning flame retardancy of polymer composites in Polytechnic University of Madrid (UPM). In 2019, Dr. Zhi Li joined School of Materials Science and Engineering of CQJTU and assisted establishing China-Spain Collaborative Research Centre for Advanced Materials (CSCRC). Currently, Dr. Zhi Li' research focuses in the hierarchical functionalization of nanomaterials for fire-safe polymers. Up to now, Dr. Zhi Li has authored 40 SCI papers in international high-level academic journals such as <i>Journal of Materials Chemistry A</i>, <i>Polymer Chemistry</i> and <i>Chemical Engineering Journal</i>. Dr. Zhi Li patents 3 domestic and foreign inventions. Currently, Dr. Zhi Li serves as the academic editor of <i>International Journal of Polymer Science</i>. As the principle investigator, Dr. Zhi Li has been ever granted by National Natural Science Foundation of China, Chongqing Municipal Science and Technology Commission, Chongqing Municipal Education Commission as well as CQJTU.</p> <p>Role of Dr. Zhi Li is to organize R&amp;D and industrialization in China to support the industrial partners.</p>
<p><b>Research facilities and Equipment</b></p>	<p>CQJTU has state-of-the-art facilities for the proposal. The most relevant for this project are:</p> <ul style="list-style-type: none"> <li>- Extrusion machine, Injection machine</li> <li>- Scanning electron microscopy</li> <li>- X-ray diffraction, Laser Particle Size Analyzer</li> <li>- High-energy milling machine</li> <li>- Limiting oxygen index and UL-94 chamber</li> <li>-Organic/Inorganic synthetic apparatus</li> </ul>
<p><b>Relevant publications / patents / products / services</b></p>	<ol style="list-style-type: none"> <li>1. Ultrafine Ni catalyst-Assembling Layered Double Hydroxide-derived Nanohybrid towards Super-efficiently Fire-safe Epoxy Resin, <i>Journal of Materials Chemistry A</i>, 2018; 6; 8488-8498</li> <li>2. Bio-based Layered Double Hydroxide Nanocarrier toward Fire-retardant Epoxy Resin with Efficiently Improved Smoke Suppression, <i>Chemical Engineering Journal</i>, 2019, 378: 122046</li> <li>3. Bioinspired Polydopamine Induced Assembly of Ultrafine Fe(OH)<sub>3</sub> Nanoparticles on Halloysite toward Highly Efficient Fire Retardancy of Epoxy Resin via An Action of Interfacial Catalysis. <i>Polymer Chemistry</i>, 2017; 8:3926-3936</li> <li>4. Natural Halloysite Nanotube-Based Functionalized Nanohybrid Assembled via Phosphorus-containing Slow Release Method: A Highly Efficient Way to Impart Flame Retardancy to Polylactide. <i>European Polymer Journal</i>, 2017; 93:458-470</li> <li>5. A Geometry Effect of Carbon Nanomaterials on Flame Retardancy and Mechanical Properties of Ethylene-Vinyl Acetate/Magnesium Hydroxide Composites, <i>Polymers</i>, 2018; 10: 1028.</li> </ol>

<b>Chinese Company 2 (China)</b>	
<p><b>General description</b></p> 	<p>Liao Ning Jinghua New Material Inc. is a state high-tech enterprise and National green factory, it was established in year 1997 and located in Liaoning Province, listed on NEEQ stock market in year 2016. Jinghua is one of the key player in chemical filler industry in China, its main products include mineral flame retardant and functional masterbatch. Jinghua company is active in plastic, rubber, EVA foam, LDPE pipe, cable, paint and coating industry, etc. Its annual sales volume is around 60000 MTs.</p> <p>Jinghua has 102 employees, it has ten sales offices in China, Jinghua is benefit from its good sales network and direct contact with customers in different industries, so it has never stopped in new product development and its goal is to become a leading functional filler company and provide professional products to fulfil customers' requirements.</p> <p>Over the past ten years, Jinghas has built long term cooperation with many universities and research institutes in the worldwide, we have also achieved some rewards, in order to achieve better and long-term development, we will insist on innovation and continuous improvement.</p>
<p><b>Role of key persons</b></p>	<p>Mrs.Xue Yang, CEO of Liao Ning Jinghua New Material Inc. China. Mrs. Yang held her Master Degree from London University King's College in UK. She has 15 years experiences as top manager to lead this company, in particular in charge of the innovation development of the products and widening the marketing in China in different field.</p> <p>In this consortium, Mrs.Xue Yang, on behalf of Liao Ning Jinghua New Material Inc. China, will be charge of introducing the new functional materials from Spanish partners to their main products (in order to improve some properties of the current products), and exploring the potential marketing in China for these new materials.</p>
<p><b>Research facilities and Equipment</b></p>	<ul style="list-style-type: none"> <li>- Production equipments: jet mill, hammer mill, single screw machine, twin screw machine, high speed mixer</li> <li>- Laboratory equipment: injection molding machine, impact testing machine, drop weight testing machine, auto oxidation inducer, Laser particle size analyzer</li> </ul>
<p><b>Relevant publications / patents / products / services</b></p>	<p>Typical new products of Liao Ning Jinghua New Material Inc. China sales to the market in China:</p> <ul style="list-style-type: none"> <li>-JH-207WZ 10000T/year,</li> <li>- BR-2000S 10000T/year</li> <li>-RB-510 5000T/year</li> <li>-RA-510H 5000T/year</li> </ul>