

## **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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**Province:** Madrid

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**Contact:** 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>	High performance fire retardant lightweight composites for railway vehicle application and/or other advanced application <b>(FIRECOMPOSITE)</b>		
<b>Duration (YM- YM)</b>	09/2021-09/2023		
<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>In recent years, polymer-based lightweight composite materials have been used as interior materials in railway vehicle to replace metal interior products. Lots of composites manufacturers found that the sandwich structure composite is the most reliable and effective technology for weight reduction of interior panels in transportation industry. However, the properties and manufacturing processes of sandwich composites are always limited by the characteristics and mechanical properties of the lightweight core material.</p> <p>IMDEA HPPN group developed a technology which can overcome the limitation of the sandwich composites state of the art. Some flame retardant lightweight sandwich composites were prepared by phenolic-epoxy resin. It is easily to prepare some artificial press compound boards with special shape. The foaming core was reinforced by short glass fiber, resulting in high mechanical properties, good thermal shield and sound insulation performance. Moreover, phenolic resin or phenolic-epoxy resin mixed with a few amount of flame retardants were used as polymer matrix and binder to endow composites excellent flame retardant performance. Thus, the lightweight composites can be applied to the Interior materials of railway vehicle to replace the metal parts such as the aluminum floor, the air duct and some wallboards.</p> <p>The flame retardant lightweight composites technologies created by IMDEA HPPN group, which will be tested according to the standard EN 45545-2. The density of foaming core is just 200 kg/m<sup>3</sup> and the panel weight is about 8 kg/m<sup>2</sup>. The thermal conductivity of sandwich composites is lower than 0.07 w/(m.k), and sound insulation is higher than 26 db when the thickness of foaming core is over 15 mm.</p> <p>The technologies of high performance lightweight composites have been used in the railway sector in China, especially in the Metro vehicles and Short-distance train vehicle. By combining with different functional layers, several functional interior products such as high sound insulation floor or wall panel (&gt; 36 db), electric heating floor can be prepared, where we think that this technology is promising and could be of interest to some manufacturers of railway vehicles with unique requirements.</p> <p>Dr.De-Yi Wang who is the technical leader/coordinator in this consortium focuses on high performance eco-friendly flame retardants</p>		

	<p>and polymer composites, have established widely collaborative networks in the materials industrial in the worldwide. The main targets of this project are to improve the value-added of the products in advanced application, such as in railway vehicle application, via innovative technology, international collaboration and marketing oriented.</p> <p>The research contents in this Project include: optimization of formulation of lightweight composite, flame retardant strategy, polymer composites processing, structure-properties relationship, trails in marketing oriented. These takes Will rely on close collaborations between two teams from Spain and China.</p> <p>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 composites related or railway manufacturing or related 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 (construction, transport, etc.) and one University (be charge of supporting some technological development to industrial partner in China) will be involved.</p>
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## 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:

Lightweight composites; Railway manufacturing; Polymer composites; Construction; Fire safety; Transport; Car Industry; Sustainable materials.

-We are looking for suitable industrial partner from Spain which are interested in developing new technology, increase the value-added of the products 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 TESCO (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>Dr. Xuebao Lin</b>, a material scientist with over 5 years' experience in the structure-properties relation of polymer composites. He got the PhD in Material Science from Sichuan University in 2016. Then work in the CRRC subsidiary for 2 years. He works as a Research Associate in Bundesanstalt für Materialforschung und –prüfung (BAM) in Germany from 2018-2019. Now he works in the IMDEA Materials in Spain for MSCA project. His research interest is in design and preparation of lightweight polymer composites.</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 Villafaña, 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.</li> </ol>

	<p>Date: 06 Sep 2016, Elsevier (Woodhead) Publishing, Print Book ISBN : 9780081009772</p> <p>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.</p>
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Chinese Company 1 (China)	
<p><b>General description</b></p> 	<p>Shenyang University of Chemical Technology is located in Shenyang City, Liaoning Province. It is a university jointly established by Sinochem Corporation and the People's Government of Liaoning Province in 1952. It is a key university in Liaoning Province's "Double First Class" and a key university in the National "Basic Capacity Building Project for Universities in the Midwest Plan". It has been selected into the national "111 plan", the National Demonstration University for Deepening Innovation and Entrepreneurship Education Reform, the Ministry of Education's Excellent Engineer Education and Training Program, the Ministry of Education's Specialty Construction Unit for Colleges and Universities, the National University Student Innovation and Entrepreneurship Training Program.</p> <p>The School of Materials Science and Engineering of Shenyang University of Chemical Technology is a key secondary college of Shenyang University of Chemical Technology. After years of development, it has achieved good results in the construction of faculty, personnel training, experimental equipment, scientific research, and discipline construction. Advanced teaching and scientific research conditions are superior. It has successively trained more than 5,000 undergraduate graduates and 300 postgraduates. The graduates are all over the country and have made extraordinary achievements in all walks of life in the motherland.</p>
<p><b>Role of key persons</b></p>	<p>Prof. Na Wang received her B.S. Degree form Shenyang University of Chemical Technology in 1999 and received her Ph.D. degree from Institute of metal research, Chinese Academy of Sciences in 2005.</p> <p>She is currently the dean of the school of materials science and engineering, Shenyang university of chemical technology. Her research interests include: (1) Preparation and application of environmental friendly flame retardant for polymer materials; (2) Environmental protection organic-inorganic nano-composites; (3) High performance polymer composites.</p>
<p><b>Research facilities and Equipment</b></p>	<p>The University 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 machaine, Injection machanie, hot press</li> <li>- Scaning electron microscopy, TEM</li> <li>- X-ray diffraction, Laser Particle Size Analyzer, FTIR</li> <li>- High-energy milling machine</li> <li>- Limiting oxygen index and UL-94 chamber, TGA, DSC</li> </ul>
<p><b>Relevant publications / patents / products / services</b></p>	<p>Publications:</p> <p>Wang N, Gao H, Zhang J, Li L, Fan X, Diao X. Anticorrosive waterborne epoxy (EP) coatings based on sodium tripolyphosphate-pillared layered double hydroxides (STPP-LDHs) [J]. Progress in Organic Coatings, 2019, 135, 74–81.</p> <p>Wang N, Teng H, Li L, Zhang J, Kang P. Synthesis of phosphated K-carrageenan and its application for flame-retardant waterborne epoxy [J]. Polymers, 2018, 10(11), 1268-1279.</p> <p>Wang N, Zhang Y, Chen J, Zhang J, Fang Q. Dopamine modified metal-organic frameworks on anti-corrosion properties of waterborne epoxy coatings [J]. Progress in Organic Coatings, 2017, 109:126-134.</p> <p>Wang N, Liu H, Zhang J, Zhang M, Fang Q, Wang D. Synergistic effect of graphene oxide and boron-nitrogen structure on flame retardancy of natural rubber/IFR composites [J]. Arabian Journal of Chemistry, 2020, 13: 6274-6284.</p> <p>Bi Q, Yao D, Yin G, You J, Liu X, Wang N, Wang D. Surface engineering of magnesium hydroxide via bioinspired iron-loaded polydopamine as green and efficient strategy to epoxy composites with improved flame retardancy and reduced smoke release [J]. Reactive and Functional Polymers, 2020, 155 (104690): 1381-5148.</p> <p>Patents:</p> <p>A flame retardant rubber (ZL201510279688.6)</p> <p>A preparation method of organometallic framework / waterborne anticorrosive coating (ZL201510222890.5)</p> <p>A preparation method of waterborne epoxy composite anticorrosive coating (ZL201510240769.5)</p>

<b>Chinese Company 2 (China)</b>	
<p>General description</p> 	<p>Shanghai Research Institute of Chemical Industry Co., Ltd. is a national key high-tech enterprise, a Shanghai high-tech enterprise, a Shanghai patent technology demonstration enterprise and a Shanghai intellectual property demonstration enterprise. Over the years, it has undertaken more than 2000 national scientific and technological research, industrialization development and engineering application projects. The scientific research achievements have received more than 500 national, provincial and ministerial science and technology awards, more than 300 national and industry standards have been formulated, 17 national key new products, more than 30 high-tech achievement transformation projects in Shanghai, hundreds of scientific research achievements and patents Technology, promote and apply at home and abroad.</p> <p>Shanghai Research Institute of Chemical Industry has been engaged in the development of flame retardant materials for a long time, and has successfully completed the "National Science and Technology Support Program "High-speed Maglev Transportation Technology Innovation and Industrialization Research" project", "Shanghai Science and Technology Commission "High-quality multifunctional plastic series additives "Key Technology Research and Development and Thousand Ton Industrialization Construction", "Shanghai Natural Science Foundation: Design of New Macromolecular Intumescent Char-forming Agent and Research on Flame Retardant Mechanism", "Ministry of Science and Technology: Multifunctional Flame Retardant Technology and Product Development" A number of scientific and technological research projects of the Ministry of Science and Technology and Shanghai Science and Technology Commission. The successful transformation of results has formed the ANTI series of flame-retardant products, which are widely used in polyolefin materials, engineering plastics, building materials and coatings. The flame-retardant series products have successively won the honorary titles of National Key New Product, National Torch Plan, Shanghai Key New Product, Shanghai Patented New Product, etc., and won the first prize of Sinopec Science and Technology Progress Award, the second prize of Shanghai Science and Technology Progress Award, Shanghai Excellent Invention Gold Award and other awards.</p>
<p>Role of key persons</p>	<p>Mr,Zhai Jinguo, senior engineer (professor level) majoring in power engineering at East China University of Science and Technology, currently serves as director, general manager and Dean of Shanghai Research Institute of Chemical Industry Co., Ltd. He has successively won special allowances from the State Council, Hou Debang Youth Science and Technology Innovation Award, Shanghai Leading Talent, Shanghai Excellent Technology Leader, and Shanghai Talent Development Fund. At the same time, he concurrently serves as the director of the Shanghai Functional Flame Retardant Material Engineering Technology Research Center and the secretary general of the Yangtze River Delta Modified Plastic Industry Technology Innovation Strategic Alliance.</p> <p>Mr. Zhai Jinguo has been engaged in material modification and chemical engineering for a long time, and has rich experience in product technology, process development and engineering design. Lead a team with a doctorate as the backbone, undertake 1 national key research and development plan project, more than 20 provincial and ministerial scientific research projects, and more than 40 horizontal projects. He has developed the ANTI series of halogen-free flame retardant products, which are widely used in home appliances, automobiles, wires and cables, etc., and achieved sales income of more than 80 million yuan.</p>
<p>Research facilities and Equipment</p>	<ul style="list-style-type: none"> <li>- Production equipment: Single screw machine, twin screw machine, high speed mixer, hot-press.</li> <li>- Production lines in the lightweight composites for advanced application</li> </ul>
<p>Relevant publications / patents / products / services</p>	<p>One of the top national technical companies in material in China. Series products have been widely provided to aeronautics, construction, transport, and railway vehicle application.</p>

**YOUR ENTITY PRODUCTS**  
**(Technologies, applications, services, etc)**

See the previous section.