

## 歐盟計畫 跨國徵求奈米材料科技於節能減碳及製程之應用計畫書 (M-ERA.NET 2-JTC2018)

歐洲公告網址: <https://www.m-era.net/>

線上申請網址: <https://www.m-era.net/>

尋求歐洲合作夥伴網址: <https://www.nmp-partnersearch.eu/>

科技部參與歐盟 M-ERA.NET 2 計畫，與歐洲各國同步公開徵求計畫書，細節請參閱 M-ERA.NET 2 網站(<https://www.m-era.net/>)之英文版公告檔案。

構想計畫書 ( pre-proposals ) 提送截止時間 : 12 June 2018, 12:00 noon

完整計畫書 ( full proposals ) 提送截止時間 : 8 November 2018, 12:00 noon

以上為布魯塞爾時間(Brussels time)為準

茲將英文版公告重要訊息摘譯/述如下，謹供參考。有意願申請者，仍請以 M-ERA.NET 2 網站隨時更新的英文公告版本為依據。

### 1.計畫宗旨(Purpose)

為提升對於低碳能源、環境以及循環經濟等議題之關注，歐盟 Horizon 2020 M-ERA.NET 2 計畫利用跨學科網絡，將有助於從卓越科學研究乃至創新的工業應用，提高知識的創造與發展。此外，本計畫也提供一平台，促進歐洲各國材料領域相關研究人員的交流互動。

歐盟 Horizon 2020 M-ERA.NET 2 計畫乃歐盟研究總署協調及整合歐洲各國科研主管機關，共同投入研發經費之跨國「奈米材料科技於節能減碳及製程之應用」計畫。M-ERA.NET 2 計畫乃由參與國的補助機構(Funding Agency)所組成，各國之 Funding Agency 自行編列研究經費，補助自己國家的研究人員參與研究計畫，以利促成「奈米材料科技於節能減碳及製程之應用」跨國研究團隊之形成，避免各國資源重複投資並集各國家所長共同研究。

本次公開徵求之主題如下：

<b>Topic 1: Multiscale modeling for materials engineering and processing (M3EP)</b>
<b>Topic 2: Innovative surfaces, coatings and interfaces</b>
<b>Topic 3: High performance composites</b>
<b>Topic 4: Functional materials</b>
<b>Topic 5: New strategies for advanced material-based technologies in health applications</b>
<b>Topic 6: Materials for additive manufacturing</b>

歐盟 M-ERA.NET 2 Call 2018 計畫參與之機構如下：

Austria	FFG
Belgium (Flanders)	VLAIO
Belgium (French Speaking Community)	FNRS
Belgium (Wallonia)	SPW
Bulgaria	BNSF
Brazil (Sao Paulo)	FAPESP
Czech Republic	TA CR
Estonia	ETAg
Germany	PTJ/PTKA
Hungary	NKFIH
Italy (Calabria)	REGIONE CALABRIA
Latvia	VIAA
Lithuania	RCL
Luxembourg	FNR
Norway	RCN
Poland	NCBR
Poland	NCN
Portugal Azores	FCRT
Romania	UEFISCDI
Russia	FASIE
Slovakia	SAS
Slovenia	MIZS
South Africa	DST
Spain	MINECO AEI
Spain (Andalucía)	IDEA
Spain (Asturias)	IDEPA
Spain (Basque Country)	INNOBASQUE
Spain (Castilla y León)	ICE
Switzerland	SBFI
Taiwan	MOST
Turkey	TÜBITAK

## 2.計畫申請 ( Application )

### 2.1 申請對象(General Eligibility)

- (1) 每件計畫必須由最少 3 個團隊，並從至少 2 個 M-ERA.NET 2 計畫參與國所組成，且必須至少有 1 個 M-ERA.NET 2 計畫參與國是歐盟會員國國家或是其協議國家，並未限制 M-ERA.NET 2 計畫參與國僅能有一個團隊參與一件計畫，單一研究計畫的執行期限最多不得超過 3 年。
- (2) 每件 M-ERA.NET 2 研究計畫的組成可包含非 M-ERA.NET 2 計畫參與國自費參加的團隊，惟前提是仍必須符合最少已有 3 個團隊從至少 2 個 M-ERA.NET 2 計畫參與國所組成，且必須至少有 2 個 M-ERA.NET 2 計畫參與國是歐洲國家之基本規定。
- (3) 每件 M-ERA.NET 2 研究計畫必須有 1 位計畫主持人(Coordinator)，且計畫主持人必須由 M-ERA.NET 2 計畫參與國家中的團隊擔任，我國亦可擔任 M-ERA.NET 2 研究計畫之計畫主持人(Coordinator)。

### 2.2 申請資格(Specific eligibility)

擬申請計畫者請確認符合所有歐盟 M-ERA.NET 2 計畫所訂定之申請資格 (Eligibility Criteria)及同時必須符合本部的申請資格(例如：必須是本部受補助單位及所提經費不得超過本部所設之上限等)。

### 2.3 申請方式(Submission of joint transnational proposals)

- (1) 所有歐盟 M-ERA.NET 2 計畫參與國之 Funding Agency 同步於 2018 年 3 月 13 日 公開徵求第一階段的構想書(Pre-Proposal)，並將於 2018 年 6 月 12 日中午 12 時 系統上(Brussels time)截止收件。
- (2) 每 1 件計畫必須由多國團隊(至少由 2 國及 3 個團隊)所組成，並委任 1 位擔任計畫

主持人 Coordinator(我國亦可以擔任 Coordinator)，共同撰寫 1 份計畫申請書，請申請人務必按照 **M-ERA.NET 2** 網站(<https://www.m-era.net/>) 上所提供之構想計畫書(pre-proposals)及完整計畫書(full proposals)表格及格式填寫，並統一由計畫主持人 Coordinator 線上繳交送出申請，同時須依程序向本部提出申請。

(3) **有意申請計畫者請透過下列網址登入 M-ERA.NET 2 計畫線上申請系統**，網址：<https://www.m-era.net/>。計畫線上申請必須提供以下資訊：

- **Project level**：計畫簡稱、計畫名稱、公開摘要(至多 1000 字)、結論(至多 4000 字)、徵求主題、關鍵字(3~7 個)
- **Partner level**：合作夥伴基本資料(任職機構、機構類型、地址、聯繫人、電子郵件、國家、補助機構、聯繫人、TRL in submitted project)、所需經費、是否為新成員(是否曾在 ERA-NETs 或其他跨國資助計畫提出申請)

(4) **Pre-to-Full-Proposal 階段之變更**

- **計畫目標不可變更**(允許依據預先提交之構想計畫書確定評估人員)
- **Consortium 不可變更**(Consortium 變更僅限於來自己屬申請前聯盟的合作夥伴，將新國家引入現有聯盟是不被接受的)
- **一般而言，應避免 Pre-to-Full-Proposal 階段的任何變更**(任何變更必須透過聯盟與各國家/區域補助機構協調)

故有關計畫內容、期限、成本、資金及聯盟夥伴的重大變更必須至少在完整計畫書提交截止日期前 4 週通知所有相關補助機構。聯盟領導須負責協調並確保所有相關合作夥伴和補助機構同意該項變更。

### 3.計畫的評估與決定(Evaluation and decision)

受理申請之 **M-ERA.NET 2** 研究計畫將經 2 階段的審查：分別為第 1 階段 Pre-Proposal 及第 2 階段 Full-Proposal。

#### 3.1 構想計畫(Pre-proposals)

(1) 第 1 階段 Pre-Proposal 是先由各 **M-ERA.NET 2** 計畫之參與國/機構所組成，按照 **M-ERA.NET 2** 之規範執行資格審查 (Eligibility Check)及初審，我國所申請或參與之 **M-ERA.NET 2** 計畫則由本部辦理資格審查及初審作業，本部將於 2018 年 6 月 12 日 Pre-Proposal 截止收件後另擇日安排初審。

(2) **M-ERA.NET 2** 計畫各參與國於執行初審結束後，將針對每一件自己國家所參與的計畫做出下列判斷：

- a. 推薦該計畫進入第二階段並邀請該計畫撰寫 Full-Proposal。

- b. 推薦該計畫進入第二階段惟必須納入審查委員之修正意見。
  - c. 不推薦該計畫進入第二階段(審查委員提供評語及說明)。
- (3) 每件 **M-ERA.NET 2** 計畫必須由至少兩個 **M-ERA.NET 2** 計畫的參與國所組成，每一件 **M-ERA.NET 2** Pre-Proposal 必須獲得至少兩個參與國之 Funding Agency 推薦才能進入第二階段，並獲邀請撰寫 Full- Proposal。如低於兩個 Funding Agency 推薦之 Pre-Proposal 則被視為未獲推薦。

### 3.2 完整計畫(Full proposals)

- (1) 通過第一階段(Pre-Proposal)審查且獲推薦計畫之主持人將會獲得正式書信通知，並獲邀於 **2018 年 11 月 8 日**前於指定的線上申請系統上繳交完整計畫書(Deadline for Submission of Full-Proposal)。
- (2) 所有進入第二階段 Full-Proposal 之計畫，每件計畫將委由 3 位審查委員<sup>1</sup>個別執行書面審查，其中一人將擔任該計畫之報告人，報告人必須彙整及評估 3 份書面審查結果並出席各國 Funding Agency 所辦理之 Full Proposal 審查會議中進行報告。
- (3) 歐盟 **M-ERA.NET 2** 計畫審查將針對每一個審查要點採分數(最高 5 分)制辦理，次審查要點(Sub-Criteria)容許採用 0.1 分制以區隔每件計畫的差異。每一個審查要點不得低於 3 分，且彙整三個審查要點分數之總和不得低於 10 分。

<i>Main Criteria</i>	<i>Sub Criteria</i>	<i>Score (points)</i>
<i>Excellence</i>	<i>Clarity and pertinence of the objectives;</i>	<i>max. 1.5</i>
	<i>Credibility of the proposed approach and soundness of the concept</i>	<i>max. 2.0</i>
	<i>Extent that proposed work is ambitious, has innovation potential, and is beyond the state of the art (e.g. ground-breaking objectives, novel concepts and approaches</i>	<i>max. 1.5</i>
<i>Impact</i>	<i>Contribution at the European or international level to the expected impacts listed in the work programme under the relevant topic</i>	<i>max. 2.5</i>
	<i>Enhancing innovation capacity and integration of new knowledge;</i>	<i>max. 1.0</i>

<sup>1</sup> 由各國所推薦之中立專家學者所組成。



	<i>Strengthening the competitiveness and growth of companies by developing innovations meeting the needs of European and global markets; and, where relevant, by delivering such innovations to the markets;</i>	
	<i>Any other environmental and socially important impacts (not already covered above);</i>	
	<i>Effectiveness of the proposed measures to exploit and disseminate the project results (including management of IPR), to communicate the project, and to manage research data where relevant</i>	<i>max. 1.5</i>
<b>Quality and efficiency of the implementation</b>	<i>Quality and effectiveness of the work plan, including extent to which the resources assigned to work packages are in line with their objectives and deliverables</i>	<i>max. 2.0</i>
	<i>Appropriateness of the management structures and procedures</i>	
	<i>Quality and relevant experience of the individual participants</i>	<i>max. 1.0</i>
	<i>Quality of the consortium as a whole (including complementarity, balance)</i>	<i>max. 1.0</i>
	<i>Appropriate of the allocation of tasks, ensuring that all participants have a valid role and allocation and justification of the resources to fulfil that role</i>	<i>max. 1.0</i>

- (4) 所有進入第二階段 Full-Proposal 之計畫將在每件計畫之報告人與會討論後，綜整評估並針對所有 Full-Proposal 產出 1 份計畫優先推薦排序表。M-ERA.NET 2 計畫參與國之 Funding Agency 將討論並決定通過 Full Proposal 之件數(按照優先推薦的計畫排序表辦理以及各國可投入之經費而判斷)。

#### 4.1 補助步驟(Funding procedure)

獲審查通過推薦之 M-ERA.NET 2 研究計畫，將由參與歐盟 M-ERA.NET 2 計畫之 Funding Agency 自行補助自己國家研究團隊所需之經費，我國之研究團隊/人員所申請或參與之計畫如最後獲審查推薦者，則由本部補助我國團隊所需之研究經費。

#### 4.2 義務(Responsibilities)

通過審查且獲得補助之計畫團隊必須簽署團隊協議(Consortium Agreement)。

#### 4.3 報告要求(Reporting Requirements)

每件獲推薦且補助之 **M-ERA.NET 2** 研究計畫，計畫主持人必須繳交期中報告及期末報告。所有報告必須用英文撰寫，不同國家之計畫成員必須配合計畫主持人 (Project Coordinator) 之協調繳交英文版之研究分項執行資料。

### 2018 年科技部徵求 (M-ERA.NET 2) 計畫說明

- 一、擬申請 **M-ERA.NET 2** 計畫者請自行尋求合作夥伴並組成團隊一起申請(Build Your Consortium)，或自行擔任 Coordinator 協調國外團隊或參與國外團隊的計畫皆可。
- 二、1 件計畫只需線上提送 1 份計畫申請書(由多國團隊共同撰寫)，故如我國研究人員與歐洲研究人員共同組成 1 隊並由歐洲人員擔任計畫主持人(Coordinator)，則由歐洲計畫主持人(Coordinator)線上一併提出 Pre-Proposal，我方則配合計畫團隊所需提供計畫相關資料；如我方乃計畫之計畫主持人(Coordinator)，則必須協調歐洲團隊提供資料，並由我方於指定時間內線上提出申請。
- 三、請依附件 Pre-Proposal 格式完成構想申請書，於 **2018 年 6 月 12 日中午 12 時 (Brussels time) 前上傳<sup>2</sup> 構想書(Pre-Proposal)至 M-ERA.NET 2 計畫線上申請系統**；**並請務必同步以 Email 方式寄送該構想計畫書至科技部湯卿嫩研究員備查 (email: [cmtom@most.gov.tw](mailto:cmtom@most.gov.tw))**。
- 四、通過第二階段(Full- Proposal)審查且獲推薦之 **M-ERA.NET 2** 研究計畫將於

<sup>2</sup> 申請一律採線上作業，從公告內所指定之網站上繳交送出。

**M-ERA.NET 2** 網站上公告，計畫主持人亦會收到正式書信通知，如我國所參與之研究計畫經第二階段(Full- Proposal)審查後獲推薦者，經聯繫本部承辦人後，可透過本部線上專題研究計畫系統提出申請(隨到隨審)，並由本部進行經費審查後核定補助經費。補助項目得包含：國外差旅費(含移地研究費)、業務費(含研究人力費(含專任助理、研究生或助理津貼、臨時工資等)、耗材、物品及雜項費用，及補助國外學者來台費用)以及管理費(上限 8%)。

五、我國研究團隊依本次計畫徵求公告申請 **M-ERA.NET 2** 研究計畫並獲審查通過後，得向本部提出申請經費補助，本部比照歐盟計畫方案辦理補助。每件獲審查通過之 **M-ERA.NET 2** 研究計畫：

1. 補助上限：新台幣 300 萬元/年(分項)<sup>3</sup>(實際補助金額經本部進行經費審查後核定)。

2. 計畫期限：最多不超過 3 年。

六、我方計畫主持人參與歐盟 **M-ERA.NET 2** 計畫得以 1 件計畫不列入本部專題研究計畫件數計算，惟將列入本部「雙邊協議專案型國際合作研究計畫」件數計算。申請人目前主持 2 件本部「雙邊協議專案型國際合作研究計畫」，且其計畫執行日期均與本次徵求案之預定執行迄日重疊達 3 個月以上者，得不受理申辦補助。

七、本部核定通過之 **M-ERA.NET 2** 研究計畫，請依本部專題研究計畫相關規定繳交研究成果及結案報告(建議用英文書寫，因為 **M-ERA.NET 2** 研究計畫團隊會向計畫成員索取 1 份)。本部亦得請我國計畫主持人至本部指定場合口頭報告，或配合本部辦理實地考評審查。

八、申請本計畫無申覆機制，一切依照歐盟制定之審查機制及各國公認的程序及方式辦理(與所有參與 **M-ERA.NET 2** 計畫會員國適用相同標準)。

九、本徵求公告未盡事宜，應依「科技部補助專題研究計畫作業要點」、「科技部補助專題研究計畫經費處理原則」及其他相關規定辦理。

十、重要日期時間表

Date	Step
13 March 2018	Launch of the Call 201

<sup>3</sup> 此 **M-ERA.NET 2** 計畫目前規範單一研究計畫必須由 3 個團隊所組成，3 個團隊當中必須包含至少 2 個 **M-ERA.NET 2** 計畫參與國，且必須至少有 1 個 **M-ERA.NET 2** 計畫參與國是歐盟會員國或是其協議國家。但並未限制單一國家僅能有一個團隊參與一個研究計畫，故如我國有兩個團隊參與同一個計畫，如於該計畫中執行不同分項，則可各別向本部申請補助新台幣 300 萬/年(上限)，或合併向本部提出一整合型計畫，向本部申請補助新台幣 600 萬/年(上限)，惟必須能夠清楚分辨出分項及工作內容的差異。



12 June 2018	Deadline for submission of Pre-Proposals
19 June 2018	Quick check access to monitoring tool list of proposals
early September 2018	National/regional Pre-Proposal checks completed and provided online via IT tool
mid September 2018	Coordination Meeting and feedback to applicants
8 November 2018	Deadline for submission of Full-Proposals
19 November 2018	Deadline for national/regional eligibility checks of Full-Proposals
20 November 2018	Start of central evaluation of Full Proposals
18 December 2018	Deadline for individual assessments by international evaluators
11 January 2019	Deadline for compilation of consensus report (online discussions and peer review report finished)
16 January 2019	Peer review reports and ranking list to call consortium
25 January 2019	National/regional commitment for funding finished (provided online via IT tool) resulting in a preliminary selection list
end January 2019	Selection Meeting – coordination of national/regional funding recommendation for final M-ERA.NET selection list
early February 2019	Feedback to applicants
from March 2019	Contract negotiations for selected proposals on national/regional level
from March 2019	Start of funded projects

十一、聯絡人：科技部科教國合司湯卿嫩研究員  
(02-2737-7557 ; [cmtom@most.gov.tw](mailto:cmtom@most.gov.tw))

科技部自然司徐文章研究員  
(02-2737-7522 ; [wenchsu@most.gov.tw](mailto:wenchsu@most.gov.tw))



附件一：本次歐盟 M-ERA.NET 2 公開徵求計畫之 6 大主題：

## **Topic 1: Multiscale modeling for materials engineering and processing (M3EP)**

### **Technical content/scope**

Current developments in combinatorial synthesis and multi-scale modeling together with high throughput or multi-scale experimentation allow for a faster development of materials targeted to both enhanced performance and processing. In addition, novel multiscale modeling and data driven strategies should be developed to expand the applicability of Integrated Computational Materials Engineering (ICME). This will lead to significant improvements to design new materials, to assess materials performance and to improve processing strategies. Projects within this topic could be basic or applied research (TRL target for project deliverables within levels 2-5).

The proposals should focus on either of the following model-driven schemes:

- a) Design of new materials with properties targeted for engineering applications;
- b) Tailoring microstructural changes of known materials to obtain new or improved properties;
- c) Creating or improving tools to advance virtual design, virtual testing or virtual manufacturing;
- d) Development of new multiscale modeling strategies to address challenges in the processing-structure-properties paradigm.

For a) and b) quantitative estimates of the target properties shall be estimated.

### **Objectives**

The proposals shall address one or several of the following items:

- Material constitutive modeling: Use of materials physics-based design principles in a computational environment, bridging the gap between different time and/or length scales.
- Data-driven modeling methods, model reduction and uncertainty quantification.
- Development of new models and modeling strategies applicable to high performance composites, multifunctional materials, biomaterials and coatings.
- Development of new models and modeling strategies for additive manufacturing.
- Experimental validation of model results across multiple length scales.

The proposals shall clearly present the approach taken for relating the above items.

### **Expected impact**

The proposal shall address how it will contribute to the expected impact of the topic, defined as follows:

- Improved predictive power of Multiscale Modeling for Materials Engineering and Processing;
- Building and strengthening a common European research community in the area of Multiscale Modeling for Materials Engineering and Processing;
- Increased competitiveness of the European industry, allowing cost saving in materials design and processing, as well as a shortened time-to-market for materials with advanced properties;
- Better predictive modeling of material behaviour and processing through novel data-driven approaches.

All proposals should address any environmental, social or ethical impacts where relevant. All proposals should clearly state the Technology Readiness Level (TRL) at the project start and at the project end (see 1.3.). In order to increase the potential for new business opportunities and commercial exploitation of the results, proposals aiming at TRL 4 and below should include a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date) and demonstrate industrial involvement, for example by establishing an industrial advisory board or by the participation of one or more companies in the project consortium. For proposals aiming above TRL 4, industrial partners should be involved in the project consortium.

#### **Target groups**

This topic is targeted at all groups in the innovation chain: basic research, applied research, industrial R&D. The topic is particularly suitable for collaboration with other topics in this call and for the establishment of a strong collaboration between research entities, SMEs and large industry.

#### **Keywords**

multiscale materials modeling, ICME, materials genome, constitutive modeling, computational simulation, computational materials science, processing-structure-properties relationships, multiphysics, experimental validation, multiple length scales, manufacturing processes, new materials.

#### **Indicative targeted TRL: 2-5**

### **Topic 2: Innovative surfaces, coatings and interfaces**

#### **Technical content/scope**

Surface and coating technology is a key enabler for new solutions in numerous industrial sectors in Europe. This call will stimulate application driven development of innovative surfaces, multifunctional coatings, interfaces, and related process technologies.

In particular, energy-related surface and coating properties are encouraged to be addressed.

The proposals should consider the processing aspect of the new technology aiming for flexible and energy-efficient approaches in production with smart use of materials (saving resources and tailoring applications) in an environmentally friendly manner.

### **Objectives**

The proposals shall address at least one of the following items:

- Development of multifunctional coatings, innovative surfaces or interfaces.
- Development or improvement of process technologies to enable deposition of new coatings and/or surface modification.

Project proposals should:

- Address innovative surface modification and coating solutions, consider innovative processing routes or new concepts for coating and surface treatment.
- Consider aspects such as: basic understanding of the mechanisms, experimental assessment, prototyping, up-scaling, manufacturing and validation with a view to final customer applications.

Where beneficial, the proposal should address use of advanced characterisation and/or modeling techniques.

In order to ensure relevance for different partners in the value chain, the proposal should state clear concepts for application(s) and targeted industrial sector(s).

### **Expected impact**

The proposals shall address how they will contribute to the expected impact of the topic, defined as follows:

- Development of innovative components/products with tailored properties or functionalities by tuned surfaces and coatings and/or related process technologies;
- Achieving a positive ecological and energy impact in terms of avoidance of hazardous materials and compounds by developing processes, coating materials, technology and product life cycles following a circular economy strategy;
- The proposals should aim at the development of innovative products or technologies based on functionalised surfaces and coatings that might have strong societal impact, on e.g. safety, economics, employment and life quality, and it is specifically encouraged that consortia should result in synergies between industry and academia.

All proposals should address any environmental, social or ethical impacts where relevant. All proposals should clearly state the Technology Readiness Level (TRL) at the project start and at the project end (see 1.3.). In order to increase the potential for new business opportunities and commercial exploitation of the results, proposals aiming at TRL 4 and below should include a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date) and demonstrate industrial involvement, for example by establishing an industrial advisory board or by the participation of one or more companies in the project consortium. For proposals aiming above TRL 4, industrial partners should be involved in the project consortium.

### **Target groups**

This topic is targeted at all groups in the innovation chain: basic research, applied research and industrial R&D. The topic is particularly suitable for the establishment of a strong collaboration between research entities and SMEs. Participation of large industry is



encouraged e.g. as potential end user of the technology proposed. Interdisciplinary projects are encouraged and should enable a broader cross-sectorial use.

### **Keywords**

functionalised surfaces, multifunctional coatings, innovative surfaces and coating materials, advanced coating and surface technologies, structured surfaces, (nano)composite coatings and multilayers, self-responsive coatings, surfaces with sensor capabilities.

### **Indicative targeted TRL: 2-6**

## **Topic 3: High performance composites**

### **Technical content/scope**

Within the scope of this call, composites are defined as engineered materials, and coatings, including hybrids, composed of two or more constituents, for example, a polymer or metallic matrix reinforced by a fibre, particle, container or a filler that meets the requirements which cannot be otherwise fulfilled by one component alone. The matrix, fibres, particles and fillers can be synthetic or bio-based. Fibres, particles, containers, and fillers can be on the nanoscale.

### **Objectives**

This call topic is aimed at high performance composites having functional properties that meet the target applications in transportation, construction, packaging and medical devices as well as other engineering applications with a particular emphasis on energy (consumption reduction, storage and production). Proposals are expected to fall into the current research categories listed above.

Regarding the properties of materials, the new developed composites should combine at least two of the following properties:

- High strength and stiffness to weight-ratio.
- High performance composites with intrinsic recycling properties.
- Recycling of waste materials to develop high performance composites.
- Durability (e.g. good resistance to creep, fatigue, humidity, etc.)
- Tailored thermal or electrical properties.
- Self-healing properties.
- Biocompatible or anti-microbial properties.
- Biodegradable and compostable properties.
- Fire retardant properties with environmentally friendly substances.
- High performance composites suitable for multiple processing techniques including additive manufacturing.

In addition to the properties of materials the research proposals could also address the following material design and manufacturing issues (descriptive of process):

- Novel and unique knowledge in molecular design, functionalization and

characterization of a wide range of fibre or filler (nano or micro) reinforced composite materials for composites with improved reinforcement/matrix interaction.

- Composite coatings.
- Development of new bio-based resins and/or bio-based fibres or fillers.
- Methodology and tools for design-optimisation.
- Scalable and rapid manufacturing, for example material innovations could encompass fast curing, low viscosity resins, stampable thermoplastic composite sheets.
- Automation and robotisation.
- Modeling and simulation of processing including multi-scale approaches or the use of data mining and machine learning (Artificial Intelligence).
- Joining, assembly and repair including solutions joining other materials.
- Structural health monitoring.
- Composite end-of-life technologies.
- Retaining economic value and energy of materials as long as possible to promote the circular economy.

To strengthen the whole innovation chain it is strongly recommended that the project proposal covers materials, processing and application development of composites. Such integration could be further enhanced by fostering collaboration between universities and industry, and by a consortium covering the whole value chain.

### **Expected impact**

The proposals shall address how they will contribute to the expected impact of the topic, defined as follows:

- More competitive industrial products and processes using the advanced materials design and manufacturing concepts;
- Socio-ecological benefits provided by products with higher integration level of functionality, lighter products to transport, lighter dynamic applications to decrease energy consumption, and by using materials that will result in a lower environmental impact;
- Because the composites industry is characterised by a large number of scattered players, including SME manufacturers and equipment suppliers, the projects should result in networks inside Europe, thereby improving the sharing of knowledge and reinforcing both technological and scientific platforms.

All proposals should address any environmental, social or ethical impacts where relevant. All proposals should clearly state and motivate at what level on the Technology Readiness Level (TRL) scale the project is situated at the beginning and after the project is finished (see 1.3.). In order to increase the potential for new business opportunities and commercial exploitation of the results, proposals aiming at TRL 4 and below should include a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date) and demonstrate industrial involvement. This can be done by establishing an industrial advisory board (or alternatively by the participation of one or more companies in the project consortium when feasible). For proposals aiming above TRL 4, industrial partners should be involved in the project consortium.

### **Target groups**

This topic is targeted at all groups in the innovation chain: basic research, applied research, industrial R&D. The particular subject of the proposal deals with the establishment of a strong collaboration between research entities, SMEs and large industry.

### **Keywords**

biobased composites, synthetic composites, hybrid material systems, polymer matrix, metal matrix, functional properties, in-service behaviour, design methodology, process technology, process modeling, artificial intelligence, recycling, material behaviour modeling, circular economy.

### **Indicative targeted TRL: 2-6**

## **Topic 4: Functional materials**

### **Technical content/scope**

Advanced functional materials are an important economic and employment generator in Europe. Functional materials are the bottleneck for almost all technologies. Design and simulation of materials and microstructures with tailored properties and appropriate process technologies are needed to achieve high performance in industrial applications. European product innovation relies strongly on more efficient technologies with new physical properties and performance. Improved materials are expected to contribute to reduce our dependence on oil, gas and coal. There is increasing concern regarding the replacement of critical raw materials, toxic materials, recycling and long term stability. The European Strategic Energy Technology Plan (SET Plan) recognizes this situation and emphasises cost-competitive low carbon energy and energy efficiency technologies. The SET Plan Materials Road Map reinforces the pivotal enabling role of advanced materials and clearly outlines the medium to long term strategy for the coming years.

### **Objectives**

Proposals within the scope of this topic should aim at the development of advanced functional materials or materials systems in at least one of the following areas:

- Materials for sensing and actuation, and ICT: smart materials/metamaterials with controlled electrical, magnetic, thermal, optical, and mechanical properties, where possible enabling low power or autonomous device/systems.
- Smart building environments: thermal insulation materials, advanced window concepts, active paints, advanced illumination concepts, efficient heat radiation solutions, etc. Electrochemical energy conversion and storage: new materials for use in rechargeable ion batteries, alternatives to graphite electrodes, new nanomaterials for supercapacitors, ionic and electronic conductors for new electrochemical storage and energy conversion concepts. Solid state batteries and capacitors. New catalysts for

fuel cells and hydrogen generation.

- Energy harvesting materials and solutions: new energy harvesting solutions based on advanced thermoelectric, caloric, piezoelectric, chemical concepts, others. New designs and architectures for increased energy efficiency.
- Photovoltaics: improved architectures for thin film solar cells, including absorbers, micro concentrators, passivation layers, controlled composition gradients, others. Novel solar cell materials (nano-based concepts, others).

### **Expected impact**

The proposals shall address how they will contribute to the expected impact of the topic, defined as follows:

- Ensure the future European energy supply through technological development based on novel multifunctional materials;
- Support the European strategic policy targets in terms of greenhouse gas emission reduction and developing affordable sustainable energy sources and usage;
- Improved competitiveness and strengthened industrial leadership;
- Strengthened innovation excellence of the European academia and research institutes.

All proposals should address any environmental, social or ethical impacts where relevant. All proposals should clearly state the Technology Readiness Level (TRL) at the project start and at the project end (see 1.3.). In order to increase the potential for new business opportunities and commercial exploitation of the results, proposals aiming at TRL 4 and below should include a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date) and demonstrate industrial involvement, for example by establishing an industrial advisory board or by the participation of one or more companies in the project consortium. For proposals aiming above TRL 4, industrial partners should be involved in the project consortium.

### **Target groups**

This topic is targeted at all groups in the innovation chain: basic research, applied research, industrial R&D.

### **Keywords**

advanced functional or multifunctional materials, electrical properties, magnetic properties, optical properties, chemical properties, thermal properties, mechanical properties, nano/microstructured materials, advanced processing technologies, sensors, ICT, photovoltaics, energy harvesting, energy conversion and storage.

### **Indicative targeted TRL: 2-5**

## **Topic 5: New strategies for advanced material-based technologies in health applications**

### **Technical content/scope**

Wellness and healthy ageing of the European population require new or improved solutions to health-related issues. Many of these solutions will come from the development of new advanced materials as key components of therapeutics (e.g. drug delivery systems, implants, tissue regeneration strategies, cell and gene therapies, etc.), diagnostics (e.g. contrast agents, implantable devices) and theranostics. These materials will be in contact with the human body at different levels. The purpose of this call topic is to provide opportunities to advance material-based technologies towards the market. This action is aligned with societal challenges regarding “Health, Demographic Change and Wellbeing” as defined in the H2020 framework. It is also in agreement with the recognition of advanced materials as a Key Enabling Technology for strengthening the competitiveness of the European industry.

### **Objectives**

The main objective is to obtain a better understanding of the functionality of biomaterials and interactions with their biological hosts (e.g. organs, body tissues, cells and human bio-fluids). Materials investigated should target at least one clinically relevant application. Proposals must address one or more of the following:

- Understanding interactions between biomaterials and biological hosts with specific focus on hierarchical structures and/or multiple time scales.
- Aspects such as biofilm formation and biodegradation.
- The crossing of biological barriers such as blood brain barrier, digestive system, skin barrier or cell membranes.
- Understanding of the impact of the sterilisation process on biomaterials.
- Use of renewable sources in synthesis of biodegradable materials.
- Application of green chemistry to comply with REACH1 regulation for eventual manufacturing process.

Proposals are expected to take into account the following:

- The potential market and exploitation routes including scalability.
- Relevant regulatory issues<sup>2</sup>.
- Where appropriate the in vitro testing and/or assays in small animals must be conducted following the national ethical rules of each relevant partner involved.

Moreover, the proposals are strongly encouraged to consider the following issue:

- Cross-collaboration between materials scientists, biologists, medical doctors and industrial partners.

### **Expected impact**

The proposals shall address how they will contribute to the expected impact of the topic, defined as follows:

- Understanding the complexity of biomaterials’ interfaces at hierarchical structures



and/or multiple time scales going far beyond the current state of the art;

- Achievement of new or improved materials performance for health applications;
- Higher competitiveness of the European health industry through more reliable products and sustainable processes;
- Improved market access through increased awareness of the regulatory protocols;
- Increased collaborations between materials science RTD performers, industrial and medical stakeholders in the health sector;
- At the end of the project the technology being addressed is expected to reach TRL 4 (see 1.3.).

All proposals should address any environmental, social or ethical impacts where relevant. All proposals should clearly state the Technology Readiness Level (TRL) at the project start and at the project end (see 1.3.). In order to increase the potential for new business opportunities and commercial exploitation of the results, proposals aiming at TRL 4 and below should include a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date) and demonstrate industrial involvement, for example by establishing an industrial advisory board or by the participation of one or more companies in the project consortium. For proposals aiming above TRL 4, industrial partners should be involved in the project consortium.

#### **Target groups**

This topic is targeted at all groups in the innovation chain: basic research, applied research, industrial RTD. Collaboration between research entities, SMEs and large industry is encouraged.

#### **Keywords:**

biomaterials, bio-interfaces, biofilms, biodegradation, nanotechnology, implants, scaffolds, sterilisation, additive manufacturing, therapeutics, diagnostics, theranostics, natural compounds, green chemistry.

#### **Indicative targeted TRL: 2-5**

### **Topic 6: Materials for additive manufacturing**

#### **Technical content/scope**

Additive Manufacturing (AM) is a process of directly building 3D parts and components based on a digital model usually by adding material layer by layer. AM is a rapidly developing industrial sector and, potentially, a disruptive technology. This is because, in principle, it is material and energy effective and sustainable compared to subtractive technologies. However, the full exploitation of 3D AM processes is currently limited due to the in-process and in-service performance of the available materials' sets. Within this call topic, proposals should focus on the development of materials specifically for use in AM processes and leading to required performance, reliability and economics of manufactured components.

## Objectives

The objective is to develop innovative metallic, ceramic, polymeric and composite materials designed for use in AM processes (e.g. tuning composition, structure, morphology, powderprocessing parameters, etc.) and advanced production systems in order to confer improved or modified properties for manufactured products. The final goal of proposed projects should be to demonstrate the ability of new materials and processes to achieve finished components exhibiting improved performance, preferably with reduced life cycle costs. Project proposals should address materials and production processes for final part production. This could include e.g. modeling of materials and processes, mechanical and corrosion properties, surface finishing, internal stress reduction, electrical and thermal conductivity, and materials specifically designed to exploit the potential of AM systems including the ability to effectively produce multimaterial structures. Proposals should also discuss energy and environmental related aspects of the research.

Proposals falling under the scope of this topic could address (but are not restricted to) the following areas:

- Development of materials and processes designed to overcome problems relating to mechanical performance and reliability of AM parts.
- Development of materials for the AM production of components for use in non-standard environments/extreme environments.
- Biomaterials for use in the production of personalized implant devices and improved scaffolds used in tissue regeneration.
- AM processing of materials used in applications with restrictive validation / certification processes, e.g. medical applications
- Development of materials and processes for improved sustainability: reducing the use of hazardous or scarce substances, promoting re-use, recycling and biodegradability of materials.
- Development of novel materials and processes to enable innovative applications for AM parts, which could include multifunctional, functionally graded, hierarchically structured, (nano-)composite materials or organic electronics.
- New materials for energy efficiency AM applications, such as heat exchangers with complex geometry or lightweight structures.

## Expected impact

The proposals shall address how it will contribute to the expected impact of the topic, defined as follows:

- Development of materials for the production of reliable AM parts/components suitable for specific application classes;
- New feedstocks (e.g. powder, wire, filament) specifically developed to enhance functionality, reliability and performance;
- New process technology for the production of AM parts with novel materials and material combinations, including hybrid processes directly combining AM with other manufacturing processes;
- New process technology adapted to the production of new AM-specific feedstock materials.

All proposals should address any environmental, social or ethical impacts where relevant. Projects within this call topic could be basic or applied research (TRL target for project within levels 3-7).

All proposals should clearly state the Technology Readiness Level (TRL) at the project start and at the project end (see 1.3.). In order to increase the potential for new business opportunities and commercial exploitation of the results, proposals aiming at TRL 4 and below should include a plan for the transition to higher TRLs at a later stage (i.e. beyond the project end date) and demonstrate industrial involvement, for example by establishing an industrial advisory board or by the participation of one or more companies in the project consortium. For proposals aiming above TRL 4, industrial partners should be involved in the project consortium.

The use of living biological materials as part of the AM process is not covered by this call topic.

#### **Target groups**

This topic is targeted at all groups in the innovation chain: basic research, applied research, industrial R&D&I. Collaboration between research entities, SMEs and large industry is encouraged as is participation in project consortia by international organisations.

#### **Keywords**

additive manufacturing, mechanical performance, production, polymers, metals, ceramics, composites, feedstock, biomaterials, life cycle costs, materials efficiency, energy efficiency, recycling, modeling.

#### **Indicative targeted TRL: 3-7**

**附件二：Technology Readiness Level (TRL) 對照表**

**Technology Readiness Level**

All proposals should clearly state and motivate at what level on the Technology Readiness Level (TRL) scale the project is situated at the beginning and after the project is finished. In order to increase the potential for new business opportunities and commercial exploitation of the results:

- Proposals aiming at TRL below 4 should include a plan for the transition to higher TRL's at a later stage (i.e. beyond the project end date) and demonstrate industrial involvement. This can be realised by establishing an industrial advisory board (or alternatively by the participation of one or more companies in the project consortium when feasible).
- For proposals aiming at TRL above 4, industrial partners should be involved in the project consortium

Where the topic description refers to the concept of “**Technology Readiness Level**” (TRL), the following definition in accordance with H2020 applies:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

In the project proposal, it should be indicated what is the TRL position in the beginning of the project and after the project is finished.

Topic	TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
Topic 1: Multiscale modeling for materials engineering and processing (M3EP)									
Topic 2: Innovative surfaces, coatings and interfaces									
Topic 3: High performance composites									
Topic 4: Functional materials									
Topic 5: New strategies for advanced material-based technologies in health applications									
Topic 6: Materials for additive manufacturing									