

DECRETO RETTORALE

Decree of the Rector n. 1542 of 11/12/2024

Competition for awarding 1 research grant at the University of Udine

DISCLAIMER:

The official and legally binding call for applications is in Italian only.

This document cannot be used for legal purposes and is only meant to provide information in English on the call for applications (Decree of the Rector n. 1542 of 11/12/2024). Please refer to the official call published on: <https://www.uniud.it/it/albo-ufficiale>

Any change and integration will be made available on the above-mentioned web page. Therefore, no personal written communication regarding the examination date and/or competition results shall be provided to applicants.

Annex 1

Call for applications for the award of 1 grant for the performance of research activities at the University of Udine on the topic "Study of an optimized composition and morphology of anode materials for Mg-ion secondary batteries" SSD: IMAT-01/A (principal investigator, Giovanni Capurso)

Research grant funded by the resources of the project PRIN 2022 - Prot. n. 20227HWBCN

Art. 1

A selection proceeding is hereby announced for the award of 1 research grant at the University of Udine for the performance of the research activity identified in Annex A, which forms an integral and substantial part of this call. The research grant is linked to the research project on which it is based and is subject to the corresponding financial coverage.

The grant may be renewed with the winner in accordance with the provisions of Article 22 of Law no. 240 of 30 December 2010 (in the text prior to Leg. Decree no. 36 of 30 April 2022, converted with amendments by Law no. 79 of 29 June 2022) and the Regulations of the University of Udine for the awarding of research grants issued by Rector's Decree no. 182 of 31 March 2021, in the presence of a positive assessment by the scientific supervisor of the activity carried out by the research fellow, adequate scientific justification and related financial coverage, within the limits set out in Article 3, letters b) and c) below.

The research grant does not entitle the successful candidate to any rights as regards access to University roles.

Any personal communication to candidates relating to this selection will be sent exclusively to the email address indicated in the application form.

DECRETO RETTORALE

Art. 2

The activities covered by the research grant referred to in this call for competition and the admission requirements are indicated and described in Annex A. Failure to meet the admission requirements at the time of applying shall result in the **exclusion** of the candidate from the selection process.

Possession of a PhD qualification or equivalent qualification obtained abroad or, for the sectors concerned only, of a medical specialisation qualification accompanied by an adequate scientific production, constitutes a preferential requirement for the awarding of the grant envisaged for this selection, if it has not been mentioned as an admission requirement.

The Selection Board shall assess, for the sole purpose of admission to the competition, the suitability of any qualification obtained abroad, without prejudice to the assessment of the medical specialisation qualification to which Article 38, paragraph 3.1 of Legislative Decree 165/2001, as amended, and the relevant Community regulations apply.

The Board assesses the qualification obtained abroad based on the relevant documentation enclosed with the application to take part in the selection and may exclude the candidate if the submitted documentation does not provide sufficient elements for the assessment.

Candidates are therefore invited to enclose all documentation in their possession relating to their qualifications in order to provide the Board with sufficient elements to assess their position.

Candidates are admitted to the selection process subject to a reservation and their exclusion, for failure to meet the requirements, may be ordered at any time by reasoned decision.

Art. 3

The research grant referred to in this call cannot be awarded to the following subjects:

- a) Employees of Universities and the entities referred to in Article 22(1) of Law no. 240 of 30 December 2010 (in the text prior to Leg. Decree no. 36 of 30 April 2022, converted with amendments by Law no. 79 of 29 June 2022).
- b) Recipients of previous research grants pursuant to Law no. 240 of 30 December 2010, for the maximum period allowed by the regulations, excluding the period in which the grant was received in conjunction with a PhD, up to the legal duration of the relevant course.
- c) Those who have already been awarded research grants and fixed-term researcher contracts pursuant to Law no. 240 of 30 December 2010 for a total of 12 years, even if not consecutive.
- d) Those who have a degree of kinship or relationship, up to and including the fourth degree, with:
 - The Rector, the Director General or a member of the Board of Directors of the University of Udine.
 - The principal investigator or a professor/researcher belonging to the department or structure of interest where the research grant activity takes place.

The research grant referred to in this call cannot be cumulated with the following:

- a) Awarded scholarships of any kind, except those granted by national or foreign institutions useful for supplementing, by means of stays abroad, the fellow's training or research activities.
- b) Other research grants.

DECRETO RETTORALE

- c) Employment relationships, even if part-time, without prejudice to the provisions of the regulations for employees of public administrations.

The grant referred to in this call is also incompatible with simultaneous attendance of degree courses, master's degrees, and PhDs with scholarships and medical specialisation, in Italy and abroad.

Persons who have been convicted of a criminal offence resulting in disqualification from holding public office or inability to contract with the public administration as a secondary penalty are not eligible for selection.

Art. 4

Applicants must submit, in the manner described in Article 5 below, the application to take part in the selection, duly signed in handwritten or digital form. An application without a signature will result in the **exclusion** of the candidate, except in the case of access through the use of the Public Digital Identity System (SPID) in which case the signature will not be necessary.

The application must be uploaded in its entirety (i.e., every page), **otherwise** the applicant will be **excluded** from the selection.

Applicants must enclose the following with their application for participation in the selection, **under penalty of exclusion**:

1. The professional scientific *curriculum vitae* in Italian or English or one of the additional languages, if any, indicated in Annex A, highlighting the candidate's aptitude for carrying out and implementing the research programme.
2. Copy of valid identity document or other identification document. Citizens of non-EU countries must enclose a copy of their passport or, if available, a copy of the Italian identity document and of the valid residence permit.
3. Limited to citizens of non-EU states residing or authorised to reside in Italy, a copy of their residence permit or authorisation to reside in Italy.
4. For candidates who cannot provide a self-certification under the conditions set out below, documentation proving possession of the academic qualification required for admission to the selection. Possession of a higher academic qualification does not exempt the candidate from producing such documentation, which, if missing, will result in exclusion:
 - **Candidates who are Italian citizens or citizens of a European Union Member State** must submit a declaration in lieu of certification and, if necessary, a notarial deed regarding the academic qualification needed for admission (indicating the academic qualification, the academic institution awarding the qualification, the year it was awarded and the mark obtained) and the publications and other qualifications held, indicating for each one all the identification details necessary for the Board's assessment. **The application for participation counts as a declaration in lieu of certification of the declared academic qualification.** If the subject matter of the declaration is not clearly identified in terms of its nature, duration, time setting and institution concerned, the selection board will disregard it. The Administration reserves the right to carry out appropriate checks on the truthfulness of the content of the declarations made; in the event of a false declaration, the provisions of Article 76 of Presidential Decree no. 445/2000 and Articles 483, 485, and 486 of the Italian Criminal Code shall apply. The University will not take into account any certificates attached by candidates who are Italian citizens or citizens of a state belonging to the European Union.

DECRETO RETTORALE

- **Citizens of a non-European Union State** must submit documents and qualifications in Italian or English or one of the additional languages, if any, indicated in Annex A, under penalty of exclusion from the selection or, as the case may be, non-assessment.
Documents and titles, originally in a different language, must be accompanied by a translation, made by the candidate under his or her responsibility, into Italian or English or any other language indicated in Appendix A. With reference to the dissertation only, the translation may be limited to an extended abstract.
- **Citizens of a non-EU State regularly residing in Italy** may use declarations in lieu of certification only in respect of states, personal qualities or facts that can be certified or attested to by Italian public bodies, without prejudice to the special provisions contained in the laws and regulations governing immigration and the status of foreigners.
- **Citizens of non-EU states authorised to reside in Italy** may use the aforementioned declarations in cases where they are produced pursuant to international conventions between Italy and the declarant's country of origin.

Applicants may also enclose with their application for assessment purposes their publications and any other qualification deemed useful to prove their qualification in relation to the research programme described in Annex A and to certify any research activity carried out in public and/or private entities (with the indication of the starting date and duration). The submission modalities are similar to those indicated in point 4 of the previous paragraph.

Only the qualifications possessed by the candidate on the date of submission of the application for selection and presented in accordance with Article 5 will be assessed.

Any exclusion from the selection procedure due to lack of eligibility requirements, absence of mandatory documents, failure to sign the application to take part in the selection or submission of the application in a manner other than that provided for in this call will be communicated to the parties concerned exclusively by email to the email address indicated in the application to take part in the selection.

Art. 5

Registration for this selection will begin on January 16, 2025 at 2:00 pm (Italian time) and will end on March 31, 2025 at 2:00 pm (Italian time).

The application to take part in the selection must be completed, under penalty of exclusion, using the appropriate online procedure, available at <https://pica.cineca.it/>.

For those who do not already have a user account, the procedure involves a registration phase for the applicant, and a subsequent phase for completing the application online.

Once completed, the application must be signed in the manner (handwritten signature, with attached identity document, or digital signature) described in the online procedure, under penalty of exclusion from the selection. The application does not have to be signed if the above-mentioned online procedure is accessed using the Sistema Pubblico di Identità Digitale (SPID - Digital ID Public System). In the case of a handwritten signature, the applicant must upload the application to the system in its entirety. The information entered in the application form shall constitute a declaration in lieu of certification and affidavit, pursuant to Articles 46 and 47 of Presidential Decree no. 445/2000.

DECRETO RETTORALE

The qualifications referred to in Article 4 must be attached to the application in .pdf format. Individual files, in .pdf format, may not exceed 30MB in size.

It is not permitted to submit attachments to the application in the form of links to files residing on "online storage/file sharing" services or web pages. Reference may not be made to documents or publications submitted to this or other administrations or documents attached to the application for participation in another selection procedure.

The application for participation in the selection is automatically sent to the University of Udine with the final closure of the online procedure.

The University Administration:

- accepts no liability if it is impossible to read the submitted documentation in electronic format due to damaged files;
- does not accept or take into consideration qualifications or documents received in paper form or by any other means than those specified in this article.

The Administration accepts no liability in the event of incorrect indication by the candidate of his/her email address or in the event of failure or delay in communicating a change in the email address indicated in the application, nor for any digital transmission errors attributable to third parties, unforeseeable circumstances or force majeure.

Applicants are advised not to wait until the last few days before the deadline to submit their application. The University accepts no liability for any malfunctions due to technical problems and/or overloading of the communication line and/or application systems.

Art. 6

The selection test takes place according to the modalities set out in Annex A.

The test will aim to ascertain the candidates' preparation, experience and research aptitude. It will consist of an assessment of the professional scientific curriculum, publications and titles submitted, and an interview, where applicable.

Failure of the candidate to attend the interview will be considered as withdrawal from the selection, whatever the cause.

Candidates who intend to avail themselves of the benefits provided for by Article 20 of Law no. 104 of 1992 (need for assistance, possible use of additional time for the performance of examination tests) in relation to their disability situation, must declare this and accompany the application with appropriate medical certification in order to allow the Administration to prepare in time the means and tools to guarantee the statutory benefits; failure to submit the medical certification exempts the Administration from any obligation in this regard.

DECRETO RETTORALE

Art. 7

The Competition Selection Board is identified in Annex A to this call, of which it forms an integral part. At its first meeting, the Board appoints the Chairperson and the Secretary taking the minutes, and establishes the criteria and procedures for assessing the qualifications and the interview, where applicable.

The results of the assessment must be made known to the parties concerned at the interview, where provided for.

The Board can attribute to the selection a total number of 100 points (one hundred hundredths). At the end of its work, the Board formulates the overall merit list based on the total marks obtained by each candidate and draws up the minutes of the competition operations.

The grant may be awarded, subject to the ranking list, to candidates who have obtained a minimum overall mark of 70/100 (seventy hundredths).

The Board's judgement is final on the merits.

The ranking list will be made public exclusively by publication on the University's official notice board; the outcome of the assessment will not be the subject of personal communication to candidates.

Those who do not declare their acceptance of the research grant and do not present themselves at the structure where the research activities are to be carried out to sign the contract by the deadline communicated by the same to the email address indicated by the candidate in the application shall forfeit their right to the research grant, except for health reasons or reasons of force majeure duly documented and promptly notified.

Candidates holding qualifications obtained abroad, if successful, must submit the following, if not already attached to the application:

- **For degrees issued by a country that is a party to the Lisbon Convention (<https://www.enic-naric.net/>), the following documentation:**
 - *Supplement* Diploma or similar certificate in English issued by the competent University.
 - "Certificate of Verification of Foreign Qualification - CIMEA" issued by CIMEA (Centre for Information on Academic Mobility and Equivalences) via the "*diplome*" service at <https://cimea.diplome.eu/udine/#/auth/login>
- **For degrees issued by a country not party to the Lisbon Convention (<https://www.enic-naric.net/>), one of the following options:**
 - Declaration of the on-site value of the qualification held and the certificate relating to the qualification with examinations and grades. The certificate in a language other than Italian or English must be accompanied by an official translation into one of those languages (certified by the competent diplomatic-consular authority or sworn at a court in Italy).
 - "Certificate of Comparability and Verification of Foreign Qualifications - CIMEA" issued by CIMEA (Centre for Information on Academic Mobility and Equivalences) via the "*diplome*" service at <https://cimea.diplome.eu/udine/#/auth/login>

DECRETO RETTORALE

If the aforementioned documentation is not available at the time of the conclusion of the contract, the candidate must prove that he or she has requested it and submit it as soon as possible; if it is not submitted within six months of the start of the contract, the candidate will forfeit the contract and will be required to repay any related sums received to date.

Art. 8

The research activity cannot be started before the contract defining the terms of the collaboration is signed.

The activity covered by the research grant must have the following characteristics:

- a) Be carried out in the context of the research programme covered by the grant and not be a purely technical support to the same.
- b) Close connection with the implementation of the research programme that is the subject of the relationship with the winner.
- c) Having a continuous and in any case temporally defined character, not merely occasional, and in coordination with the overall activity of the University.
- d) Performance in a condition of autonomy, within the sole limits of the programme prepared by the Head of the same, without predetermined working hours.

The research fellow is obliged to submit a detailed written report on the work carried out and the results achieved, together with the opinion of the scientific supervisor, to the reference structure within the deadlines laid down in the contract. The research fellow will also have to submit interim reports and time sheets if requested by the reference structure and/or the scientific supervisor.

The research fellow is bound to strict confidentiality regarding the data and information to which he/she becomes privy in the course of his/her research activity. At the request of the scientific coordinator, he/she will be required to sign an appropriate confidentiality agreement.

The industrial property rights to the results obtained by the research fellow in the performance of the research activity belong exclusively to the University, without prejudice to the moral right of the research fellow to be recognised as an author or inventor.

The University reserves the right to revoke this call for competition for reasons of public interest, should the research project and/or the financial backing on which the research grant is based cease to exist. Should these causes arise after the contract has been signed, the University may terminate the contract without notice.

Art. 9

The following apply to the grant under this call:

- On tax matters, the provisions of Article 4 of Law no. 476 of 13 August 1984, as amended.
- On social security matters, the provisions of Article 2(26) et seq. of Law no. 335 of 8 August 1995, as amended.
- On compulsory maternity leave, the provisions of the Ministerial Decree of 12 July 2007.
- On sick leave, the provisions of Article 1(788) of Law No 296 of 27 December 2006, as amended.

DECRETO RETTORALE

During the period of compulsory maternity leave, the allowance paid by INPS pursuant to Article 5 of the Ministerial Decree of 12 July 2007 is supplemented by the University up to the full amount of the research grant.

The grant will be paid in monthly instalments in arrears.

Art. 10

The data collected as part of the procedure referred to in Article 5 is necessary for the proper management of the selection procedure, for the possible subsequent management of the research grant and purposes related to the management of the services provided by the University. The University of Udine is the Data Controller. At any time, the data subject may request access, rectification and, compatibly with the institutional purposes of the University, cancellation and restriction of processing or may object to the processing of his/her data. He/she can always lodge a complaint with the Italian Data Protection Authority. The full information is available on the University of Udine website in the "Privacy" section accessible from the home page www.uniud.it Direct Link: <https://www.uniud.it/it/it/pagine-speciali/guida/privacy>

Art. 11

For any matters not expressly mentioned in this call, reference is made to the relevant regulations in force cited in the introduction and to the "Internal regulations for the award of research grants pursuant to Law no. 240 of 30 December 2010" of the University of Udine issued by Rector's Decree no. 182 of 31 March 2021.

Art. 12

The official in charge of the proceeding is Dr. Sandra Salvador, Head of the Research Services Area of the University of Udine.

The reference office at the University of Udine is the "Area Servizi per la Ricerca - Ufficio Formazione per la Ricerca", Via Mantica 31 - 33100 Udine.

To request information on the call, please complete the following form available on the University of Udine website: https://helpdesk.uniud.it/SubmitSR.jsp?type=req&accountId=universityofudine&populateSR_id=42105

DECRETO RETTORALE

Annex A

Responsabile scientifico della ricerca / Principal investigator:

Nome e cognome / Name and surname: Giovanni Capurso
Qualifica / Position: Professore Associato / Associate Professor
Dipartimento / Department: Politecnico di Ingegneria e Architettura (DPIA) / Polytechnic of Engineering and Architecture
Area MUR / Research field: 09 - Ingegneria industriale e dell'informazione
Settore concorsuale e Settore scientifico disciplinare / Scientific sector: 09/IMAT-01; IMAT-01/A – Scienza e tecnologia dei materiali

Titolo dell'assegno di ricerca / Topic of the research fellowship "assegno di ricerca":

I bandi sono consultabili dal sito dell'Ateneo, del MUR e di Euraxess / The calls are available on the University, MUR and Euraxess websites

Testo in italiano:

Studio di una composizione e morfologia ottimizzata di materiali anodici per batterie secondarie agli ioni di Mg.

Text in English:

Study of an optimized composition and morphology of anode materials for Mg-ion secondary batteries.

Obiettivi previsti e risultati attesi del programma di ricerca in cui si colloca l'attività dell'assegnista di ricerca / Foreseen objectives and results of the research programme performed by the research fellow "assegnista di ricerca":

I bandi sono consultabili dal sito dell'Ateneo, del MUR e di Euraxess / The calls are available on the University, MUR and Euraxess websites

Testo in italiano:

Il progetto **FULLnanoBAT** esamina la realizzazione dei materiali per batterie al Mg allo stato solido, combinando ed esplorando compositi nanostrutturati, studiando le interfacce con un approccio multi-tecnica e grazie alle competenze complementari dei partner. L'ambizioso obiettivo del progetto è quello di assemblare una cella completa per batterie al Mg in nanocomposito allo stato solido e chiarire il meccanismo di reazione alle interfacce solide.

Le batterie agli ioni di Mg costituiscono un notevole progresso nella tecnologia delle batterie, essendo il magnesio abbondante, facilmente inseribile in un'economia di scala, e riciclabile; è molto meno reattivo in aria rispetto al Li e più sicuro da maneggiare. Come portatore di carica bivalente, Mg^{2+} garantisce inoltre un'elevata capacità volumetrica (3832 mAh/cm^3). È possibile ottenere un'efficienza coulombiana prossima al 100 % per il *plating/stripping*, poiché solitamente si verifica una deposizione di Mg priva di dendriti, da migliorare ulteriormente con un elettrolita allo stato solido. Progettare una combinazione elettrolita-elettrodi appropriata potrebbe portare a una densità di energia di 320 Wh/kg .

Con questo scopo in mente, i materiali allo stato dell'arte includono, per l'anodo: Mg elementare, che ha caratteristiche promettenti, ma compatibilità limitata con molti elettroliti, a causa delle reazioni di superficie e all'interfaccia. Le leghe di Mg con Sn, Bi, Pb, In o Sb ampliano la gamma di elettroliti utilizzabili; ad esempio, lo Sn offre una barriera di diffusione di ioni Mg a bassa energia ($0,395 \text{ eV}$) e una capacità teorica di 911 mAh/g come materiale anodico. Mg_2Sn può scambiare 4 elettroni/atomo di Sn, ma il suo cambiamento di volume durante il processo di *plating/stripping* porta a una scarsa stabilità elettrochimica in cicli prolungati. Gli stessi problemi si osservano per l'intermetallico Mg_3Bi_2 , che può scambiare 3 elettroni per atomo di Bi con una buona capacità volumetrica (3783 mAh/cm^3) e buone prestazioni cinetiche. Le leghe bifasiche potrebbero rappresentare una strategia intelligente per migliorare le proprietà degli elettrodi, attraverso un aumento del disordine nella struttura

DECRETO RETTORALE

cristallina (maggiore densità dei bordi grano) che facilita la diffusione degli ioni Mg. Sempre al fine di favorire il movimento degli ioni, si ha lo studio di nanostrutture e di interfacce ottimizzate.

Lo sviluppo del materiale anodico sarà eseguito dal ricercatore selezionato e seguirà principalmente due percorsi. I primi passi si concentreranno sui materiali disponibili ed esploreranno le migliori composizioni di leghe a base di Mg e materiali intermetallici, per valutarne le proprietà con i metodi elettroanalitici disponibili (spettroscopia di impedenza elettrochimica – EIS, voltammetria ciclica – CV, ...) su polipotenziostati. Per le sintesi di queste leghe possono essere applicate sia tecniche metallurgiche più classiche (fusione in forno, ad arco, ad induzione) sia alternative più avanzate (macinazione e *mechanical alloying*), tenendo a mente le problematiche legate al basso punto di fusione e alla bassa pressione di vapore di molti dei componenti più interessanti (Mg, Sn, Bi, ...). In questa fase, verrà valutato anche il miglioramento delle proprietà meccaniche, favorevoli alla fabbricazione di lamine sottili o altre strutture ad alta superficie, insieme all'influenza che gli elementi che promuovono la duttilità hanno sull'elettrochimica. La possibilità di utilizzare metalli riciclati come fonte di Mg elementare o in lega, potrebbe anche essere studiata in questa fase, valutando l'influenza di elementi comuni trovati in tracce nei materiali commerciali e dimostrando la fattibilità del riciclo di materiali. Dopo alcuni test e cicli per comprendere meglio la rideposizione di Mg sugli anodi (*Mg plating*), le caratteristiche dei depositi dovrebbero essere meglio analizzate e utilizzate per recuperare informazioni per migliorare il processo, senza incorrere in morfologie dannose o nella formazione di uno strato di passivazione. Lo studio di questi fenomeni in diverse condizioni elettrochimiche e in diversi ambienti può suggerire la strada migliore per ottenere una superficie/materiale anodico ottimizzati. Questa caratterizzazione si basa su tecniche che osservano le caratteristiche morfologiche dei depositi e delle interfacce, come la microscopia elettronica a scansione (SEM), la microscopia a forza atomica (AFM) e la spettroscopia di emissione ottica a scarica luminescente (GD-OES) e che possono anche analizzarne la composizione chimica. Un secondo ciclo di campioni ed esperimenti si concentrerà sulle composizioni selezionate più performanti e sarà dedicato agli aspetti morfologici. La tecnica *ball milling/mechanical alloying* può essere utilizzata proficuamente per aumentare il livello di disordine e cristalliti nano-dimensionali nel materiale finale. Inoltre, l'uso di polveri consente di valutare l'influenza della porosità sulle proprietà elettrochimiche. Per ottenere anodi nanostrutturati e/o nano-porosi, è anche previsto l'uso di tecniche di corrosione selettiva/*de-alloying*. Oltre alle tecniche utilizzate in precedenza, le proprietà superficiali e la distribuzione dei pori saranno determinate dalle isoterme di adsorbimento di N₂. Questa seconda fase di test si concluderà con una completa caratterizzazione degli elettrodi dopo il loro utilizzo e diversi cicli. I test sui materiali anodici con elettroliti compatibili sono complementari a uno studio successivo, condotto con elettroliti allo stato solido per studiare in dettaglio le interazioni superficiali, sia con metodi elettroanalitici che con altri strumenti, per migliorare il contatto, lo scambio ionico e la cinetica complessiva. Il *plating/stripping* che avviene in questo caso richiede un controllo accurato dei fenomeni che si verificano tra due solidi; pertanto, saranno coinvolti molti altri parametri e conoscere separatamente il comportamento degli elettrodi e degli elettroliti consente un'indagine più mirata sulla semicella assemblata e sulla cella completa.

Text in English:

The project **FULLnanoBAT** looks at tailoring solid-state Mg-battery materials by combining and exploring nanostructured composites, investigating interfaces by a multi-technique approach and thanks to the complementary expertise of the partners. The ambitious goal is to assemble a full solid-state nanocomposite Mg-battery cell and elucidate the reactions mechanism at the solid interfaces.

Mg-ion batteries constitute a great advance in battery technology, being Mg abundant, easily scalable, and recyclable, much less reactive in air than Li, and safer to handle. As a divalent charge carrier, Mg²⁺ guarantees a high volumetric capacity (3832 mAh/cm³). A coulombic efficiency close to 100 % for plating/stripping can be achieved since a dendrite-free Mg deposition usually occurs, to be further improved with a solid-state electrolyte. Designing a proper electrolyte-electrodes combination could lead to an energy density of 320 Wh/kg.

With this purpose in mind, state-of-the art materials include, for the anode: elemental Mg, which has promising characteristics, but limited compatibility with many electrolytes due to surface and interface reactions. Mg-alloys with Sn, Bi, Pb, In, or Sb expand the range of usable electrolytes, e.g., Sn offers low energy Mg-ion diffusion barrier (0.395 eV) and 911 mAh/g theoretical capacity as anode material. Mg₂Sn can exchange 4 electrons/Sn-atom, but its

DECRETO RETTORALE

volume change during the plating/stripping process leads to poor electrochemical stability in prolonged cycling. The same issues are observed for Mg_3Bi_2 intermetallic that can exchange 3 electrons/Bi-atom with good volumetric capacity (3783 mAh/cm^3) and good kinetic performances. Biphasic alloys could represent a clever strategy to improve the electrode properties, through an increase of the disorder in the crystal structure (higher grain boundaries density) that facilitates the diffusion of Mg ions. In the same direction is the study of nanostructures and improved interfacial design.

The development of anodic material will be performed by the selected researcher and will pursue mainly two routes. The first steps will focus on bulk materials and explore the best compositions of Mg-based alloys and intermetallic materials, to assess their properties with the available electroanalytical methods (electrochemical impedance spectroscopy – EIS, cyclic voltammetry – CV, ...) on poly-potentiostats. For the syntheses of these alloys both more classical metallurgical techniques (furnace/arc/induction melting) and more advanced alternative ones (mechanical alloying) can be applied, keeping in mind the challenges linked to the low melting point and low vapor pressure of many of the promising components (Mg, Sn, Bi, ...). In this phase, the improvement of mechanical properties, favorable for the fabrication of thin foils or other high surface structures, will also be assessed together with the influence that ductility-promoting elements have on electrochemistry. The possibility to use recycled metals as a source for elemental/alloyed Mg could also be investigated in this phase, evaluating the influence of common elements found in traces in commercial materials and proving the viability of materials recycling. After a few tests and cycles to understand better the re-deposition of Mg on the anodes (Mg plating) the features of the deposits should be better analyzed and used to retrieve information to improve the process, without incurring detrimental morphologies or the formation of a passivation layer. The study of these phenomena under different electrochemical conditions and in different environments can suggest the best route to achieve enhanced anode surface/material. This characterization is based on techniques that observe the morphological characteristics of deposits and interfaces, such as scanning electron microscopy (SEM), atomic force microscopy (AFM), and glow-discharge optical emission spectroscopy (GD-OES) and that can analyze their chemical composition too. A second round of samples and experiments will focus on selected best performing compositions, and it will be devoted to the morphological aspects. The mechanical alloying/ball milling technique can be profitably used to increase the level of disorder and nano-sized crystallites in the final material. Moreover, the use of powders allows the assessment of the influence of porosity on the electrochemical properties. To achieve nanostructured and/or nano-porous anodes, the use of selective corrosion/de-alloying techniques is also planned. In addition to the techniques used before, surface properties and pore distribution will be determined by N_2 adsorption isotherms. This second phase of tests is going to be concluded by a complete characterization of the electrodes after their use and several cycles. Tests on anode materials with compatible electrolytes are complementary to a subsequent study, carried out with solid-state electrolytes to study surface interactions in detail, both with electroanalytical methods and with other tools, to improve the contact, the ion exchange, and the overall kinetics. The plating/stripping occurring in this case requires an accurate control of the phenomena occurring between two solids, therefore many other parameters will be involved and knowing the behavior of electrodes and electrolytes separately allows a narrower investigation on the assembled half-cell and full cell.

Struttura dell'Università di Udine presso la quale verrà sviluppata l'attività di ricerca / Department or other structure of the University of Udine where research activities will be carried out:

Dipartimento Politecnico di Ingegneria e Architettura (DPIA). / Polytechnic Department of Engineering and Architecture.

Importo dell'assegno di ricerca (al lordo oneri carico assegnista) / Total grant gross for the research fellowship:

€ 19.456,00

Research, Libraries and Third Mission Directorate
Research Education Office

Directorate manager: Sandra Salvador

Office manager: Raffaella Medeot

Person in charge of the proceeding: Sandra Salvador

Drafter: Francesca Mion

DECRETO RETTORALE

Durata dell'assegno di ricerca / Duration of the research fellowship "assegno di ricerca":

12 mesi / months

Finanziamento / Financed by:

La copertura finanziaria graverà sul progetto PRIN 2022 – "FULLnanoBAT – FULL solid-state NANOstructured electrodes and nanocomposite electrolytes for magnesium BATtery: elucidating interfaces influence on ion intercalation"; Prot. n. 20227HWBCN. Decreto direttoriale MUR n. 1401 del 18/09/2024 "Disposizioni per lo scorrimento delle graduatorie" relativo al bando PRIN 2022 (Decreto direttoriale 2 febbraio 2022, n. 104). Decreto di finanziamento n. 20435 del 06/11/2024 - Settore PE8. Codice CUP G53C24000790006. Ministero dell'Università e della Ricerca.

Requisiti di ammissione / Minimum qualifications necessary:

Possesso di un diploma di laurea vecchio ordinamento (ante decreto 3 novembre 1999 n. 509) o di laurea specialistica/magistrale (ex decreto 3 novembre 1999 n. 509 e decreto 22 ottobre 2004 n. 270) o titolo equivalente conseguito all'estero. / Possession of a University degree obtained before Decree n. 509 of 3 November 1999 or specialistic/Master's degree (post decree n. 509 of 3 November 1999 and decree n. 270 of 22 October 2004) or equivalent degree obtained abroad.

Modalità di presentazione della documentazione oggetto di valutazione / Arrangements for the submission of documents:

La modalità di presentazione della documentazione oggetto di valutazione è specificata all'art. 4 del bando. / The way of presenting the documentation under evaluation is specified in art. 4 of the present notice.

Ai fini valutativi, i candidati potranno presentare le pubblicazioni e ogni altro titolo ritenuto utile a comprovare la propria qualificazione in relazione al programma di ricerca descritto nell'Allegato A, nelle seguenti lingue: / For evaluation purposes, candidates may present publications and any other qualifications deemed useful to demonstrate their qualification in relation to the research program described in Attachment A, in the following languages:

- Italiano / Italian
- Inglese / English

Procedura selettiva / Competition procedure:

Valutazione per titoli e colloquio. / Evaluation of titles and oral exam.

I risultati della valutazione dei titoli saranno resi noti agli interessati nel corso del colloquio. / The evaluation of the qualifications will be disclosed to candidates during the interview.

Calendario del colloquio / Calendar of the oral exam	Modalità / Modality	Videoconferenza / Videoconference
	Data / Date	10 aprile / April 2025
	Ora / Time	9:00 / 9:00 am (Italian time)
	Luogo / Place	-

DECRETO RETTORALE

Per sostenere il colloquio i candidati devono esibire un valido documento di riconoscimento. / Candidates must come to the interview with a valid identity document.

Eventuali variazioni saranno rese note esclusivamente mediante pubblicazione all'albo ufficiale on line dell'Ateneo / Any change will be made public solely through publication on the University web site http://web.uniud.it/ateneo/normativa/albo_ufficiale

Nota / Note: Le indicazioni sulle modalità di svolgimento della prova in modalità telematica saranno inviate ai candidati con successiva email da parte del Presidente della Commissione. Ai fini dell'identificazione e a pena di esclusione dalla procedura selettiva, ciascun candidato è tenuto ad identificarsi prima che il colloquio abbia inizio, esibendo il medesimo documento di identità allegato alla domanda di ammissione al concorso. Il candidato deve risultare reperibile nella giornata e all'orario indicato sul bando. Il mancato collegamento, l'irreperibilità del candidato nel giorno o nell'orario stabilito o la mancata esibizione del documento identificativo, sono motivo di esclusione dalla procedura selettiva. La registrazione delle prove orali è vietata. L'Ateneo adotterà pertanto tutti i provvedimenti in suo potere per tutelare i soggetti coinvolti qualora venissero diffuse tramite internet – o altri mezzi di diffusione pubblica – video, audio o immagini della procedura selettiva. / Instructions on how the video interviewing will be conducted will be provided to candidates by the Chairman of the Examining Board via email. For identification purposes, each candidate is required to identify him/herself before the interview by exhibiting the same identification document attached to the application. Candidates must be available on the day and time established by the call for applications. Failure of the candidate to establish a video connection, the unavailability of the candidate on the day and/or time established or failure of the candidate to provide the required identification document are all grounds for exclusion from the selection procedure. Recording of the video interviews is prohibited. The University will adopt all the measures within its power to protect all personnel involved as a result of dissemination via the internet or via other forms of public dissemination, of videos, audios or other pictures of the selection procedures.

Commissione giudicatrice / Examining Board:

Nome e Cognome	Qualifica	SSD	Università
Membri Effettivi / Permanent members			
Giovanni Capurso	PA	IMAT-01/A	Università degli Studi di Udine
Alfredo Rondinella	RTD	IMAT-01/A	Università degli Studi di Udine
Matteo Zanocco	RTD	IMAT-01/A	Università degli Studi di Udine
Membri Supplenti / Temporary members			
Francesco Andreatta	PA	IMAT-01/A	Università degli Studi di Udine
Alex Lanzutti	PA	IIND-03/C	Università degli Studi di Udine