 

# **ADAM MICKIEWICZ UNIVERSITY, POZNAN**

**ANNOUNCE A COMPETITION**

**for the position of Postdoctoral Researcher**

**at the Faculty of Physics**

**in the project**

**Nanomechanics of van der Waals materials, molecular layers, and heterostructures (2PLUS2)**

**number UMO-2024/54/E/ST3/00232**

**Basic information**

1. **Research discipline (research field): PHYSICS**
2. **Number of work hours per week, including a task-based work schedule (if applicable):**

**Full-time position, 40h/week in a task-based work time system.**

1. **Type of an employment contract and expected duration of employment:**

**Fixed-term contract for 2 years (possible 1-year extension)**

1. **Anticipated job starting date:**

**01.10.2025**

1. **Workplace location: AMU Faculty of Physics and Astronomy**
2. **Monthly salary:**

**Gross salary approx. 9 000 PLN/month.**

1. **Application deadline and process:**

**Electronic submission to bartlomiej.graczykowski@amu.edu.pl. Application deadline: 15.08.2025.**

1. **Required documents**

* Application form/letter of the candidate;
* *Curriculum Vitae (Max. 4 pages A4);*
* Diplomas or certificates issued by colleges and universities attesting to education and degrees or titles held (in case of academic degrees obtained abroad - the documents must meet the equivalence criteria set out in Article 328 of the Act of 20 July 2018 Law on Higher Education and Science (Journal of Laws of 2023, item 742 ; Polish: Dziennik Ustaw 2023 poz. 742 t.j.);
* Candidates who do not yet have a doctoral degree may apply if they plan to obtain it by the date of signing the employment contract.
* Information on the Applicant's research (publication record and list of conferences attended), teaching, and organizational achievements
* Two letters of support (not older than 2 months)
* Consent to the processing of personal data as follows : *In accordance with Article 6 (1) (a) of the General Data Protection Regulation of 27 April 2016. (OJ EU L 119/1 of 4 May 2016) I consent to the processing of personal data other than: first name, (first names) and surname; parents' first names; date of birth; place of residence (mailing address); education; previous employment history, included in my job offer for the purpose of the current recruitment.";*

**Conditions of the competition determined by the competition** **committee**

1. **Determination of qualifications: (researcher profile) according to the Euraxess guidelines**

**(R2)** **Recognised Researcher** (PhD holders or equivalent who are not yet fully independent)

1. **Job Offer description**

In 2011, the scientific community got excited with a tweet: "*It would take an elephant, balanced on a pencil, to break through a sheet of graphene the thickness of cling film.*"  Since 2007, graphene has entered the collective consciousness as a wonder, super-durable material and, as a forerunner, triggered extensive research on van der Waals (vdW) materials. In the scientific community, it is evident that 2D materials will revolutionize our technology. Today, the question is "when" this will happen. **On the other hand, the mechanical fragility of freestanding 2D vdW materials remains the critical bottleneck for their mass fabrication and application in durable everyday devices.**

Considering state-of-the-art and forecasted cutting-edge research on vdW materials, it begs the question: **Can we create unambiguous and comprehensive empirical knowledge to reach the technological level that allows for predictive design and fabrication of mechanically robust 2D vdW structures?** Furthermore, from the point of view of common knowledge, we may ask: **What causes the discrepancy between repeatedly announced superior elastic properties of vdW materials when confronted with today's modest possibilities of mass production of durable structures?** Available experimental work on elastic features of vdW shows a vast disproportion between the number of studies devoted to 2D and bulk vdW materials. Thus, knowledge about bulk, which should be the foundation for further research, is rudimentary. Today, it is possible to piece together molecular layers in a LEGO-like approach and create stacking multifunctional vdW structures. At the same time, it is highly desired that a similar, atomically precise degree of manipulation of elastic properties be possible. The critical question arises:

**Do we have experimental tools for an unambiguous and complete mechanical assessment of vdW materials from bulk to the single molecular layer and their complex nanostructures?**

Based on the literature overview, we can figure out that the elasticity of bulk vdW materials remains sparsely examined experimentally compared to theoretical studies. Most standard techniques require large different-cut samples, while vdW are small, flaky crystals limited to cleavage planes and flat surfaces. In the case of single- and few-layer vdW materials, the most standard technique, i.e., atomic force microscopy (AFM), is a contact-like method inherently perturbing the measured system. Thus, the reported values do not lead to any clear consensus regarding the size dependence of the elastic features.At the same time, there is a great need for a framework combining complementary experiments and simulations supported with AI machine learning for predictive scaling of the mechanical behavior of simple and complex 2D materials. To this day, the experimental part of this story remains uncharted territory.

The project **aims** to pick up this gauntlet and **unravel the nanomechanical properties of vdW materials from bulk to a single molecular layer utilizing state-of-the-art all-optical tools. In particular, we will focus on TMDCs and perform the first complex experimental investigation of the impact of spatial confinement, lattice twist, and intralayer coupling on the intrinsic elasticity of freestanding structures.**

To address these challenges, we will develop a novel contactless experimental platform that employs all-optical methods, utilizing inelastic light scattering on both thermal and nonthermal phonons. In this way, we will access intrinsic anisotropic elastic features of Transition Metal Dichalcogenides (TMDCs) ranging from bulk to a single molecular layer and their complex stacking heterostructures. This project outcome will provide the fundamental knowledge essential for the predictable fabrication of robust van der Waals (vdW) molecular layers and heterostructures. **The groundbreaking nature of the project** stems from its innovative experimental platform for the elastic evaluation of bulk and 2D van der Waals (vdW) materials. We will go beyond today's experimental routine of contact-like tools and utilize an all-optical contactless and nondestructive approach based on inelastic light scattering on phonons. In particular, we will employ Brillouin light scattering as the core part of the experimental setup, expand its capabilities to the technological limit, and measure the speed of all possible acoustic phonons needed for the complete elastic evaluation.

**In particular, the postdoctoral researcher will be responsible for:**

1. Preparation of an experimental setup for the production of monolayers and membranes from vdW materials.Preparation of samples from vdW single crystals (thin films, membranes and heterostructures).
2. Characterization of samples using SEM, TEM, AFM and ellipsometry.
3. Reporting, preparation of manuscripts for publication and public presentation of results.
4. Short-term (approx. 4 weeks per year) foreign assignments dedicated to sample production (Spain, the Netherlands and Japan).
5. **Requirements and qualifications**

The competition is open to individuals who meet the requirements specified in Article 113 of the Law on Higher Education and Science of 20 July 2018 (Journal of Laws of 2023, item 742, Article 113 as amended) and who meet the following requirements:

1. **PhD in physical sciences or materials engineering.**
2. Fulfilled formal requirements regarding the date of obtaining the doctoral degree in accordance with the regulations of the National Science Center https://www.ncn.gov.pl/sites/default/files/pliki/uchwaly-rady/2021/uchwala81\_2021-zal1.pdf. Persons who do not have a doctoral degree may apply, provided they plan their defense no later than the date of signing the employment contract.
3. Proven experience in writing scientific publications.
4. In the case of a person who does not yet have a doctoral degree, a certificate of the planned date of defense.
5. **Required languages**

* **Language: English (fluent or native)**

1. **Required research, teaching or mixed experience**
   * Ph.D. in physics or materials engineering recognized in Poland (https://kwalifikator.nawa.gov.pl/).
   * Experience in working with vdW materials
   * Experience in using SEM, TEM and AFM imaging techniques.
   * Independence, good work organization, ability to work in a team.
   * Availability: the project includes research in teams of project partners
   * Experience in writing scientific publications and conference presentations.
   * Knowledge of software such as: Mathematica, Matlab (or LabView), OriginLab, COMSOL, CorelDraw, LaTex.
   * An additional advantage will be knowledge of issues from solid-state mechanics, polymer physics, heat transport and nanofabrication.
2. **Benefits**

* an atmosphere of respect and cooperation
* supporting employees with disabilities
* flexible working hours
* funding for language learning
* co-financing of training and courses
* additional days off for education
* life insurance
* pension plan
* savings and investment fund
* preferential loans
* additional social benefits
* leisure-time funding
* subsidizing children's vacations
* "13th" salary

1. **Eligibility criteria**
2. Compatibility of the candidate's scientific profile with the advertisement (40/100 points).
3. Number, scientific level and thematic compatibility of the candidate's scientific publications and presentations (40/100 points).
4. Assessment on the doctoral diploma (10/100 points).
5. Internships and participation in research projects (10/100 points).
6. **The selection process**
7. Competition committee begins working no later than 14 days after the deadline for submission of documents.
8. Formal evaluation of submitted proposals.
9. Call to provide additional or missing documents if necessary.
10. Selection of candidates for the interview stage.
11. Interviews for candidates who meet the formal requirements.
12. The chair of the competition committee announces the results and informs the candidates. This information will include justification with a reference to candidates' strengths and weaknesses.
13. **Prospects for professional development**

- supervision in building a scientific profile through the publication in high-impact scientific journals,

- assistance in writing grant applications in domestic (FNP, NCN) and foreign (MSCA, Humboldt) research projects,

- establishing cooperation with renowned research centers in the world.

**RODO Information Clause :**

Pursuant to Article 13 of the General Data Protection Regulation of 27 April 2016. (Official Journal of the EU L 119 of 04.05.2016) we inform that:

1. The controller of your personal data is Adam Mickiewicz University, Poznań with the official seat: ul. Henryka Wieniawskiego 1, 61 - 712 Poznań.
2. The personal data controller has appointed a Data Protection Officer overseeing the correctness of the processing of personal data, who can be contacted via e-mail: iod@amu.edu.pl.
3. The purpose of processing your personal data is to carry out the recruitment process for the indicated job position.
4. The legal basis for the processing of your personal data is Article 6(1)(a) of the General Data Protection Regulation of 27 April 2016 and the Labour Code of 26 June 1974. (Journal of Laws of 1998 N21, item 94 as amended).
5. Your personal data will be stored for a period of 6 months from the end of the recruitment process.
6. Your personal data will not be made available to other entities, with the exception of entities authorized by law. Access to your data will be given to persons authorized by the Controller to process them in the performance of their duties.
7. You have the right to access your data and, subject to the law, the right to rectification, erasure, restriction of processing, the right to data portability, the right to object to processing, the right to withdraw consent at any time.
8. You have the right to lodge a complaint to the supervisory authority - the Chairman of the Office for Personal Data Protection, ul.Stawki 2, 00 - 193 Warsaw.
9. Providing personal data is mandatory under the law, otherwise it is voluntary.
10. Your personal data will not be processed by automated means and will not be subject to profiling.