1	CEIPEX RESEARCH TOPIC LEVEL2: future energy
2	RESEARCH GROUP: **Future Energy and Innovation Lab (M. Pumera)**
3	TOPICS/FOCUS: **Topic A: Nanorobots for Biomedical and Environmental Applications** **Topic B: Next Generation Materials for Flexible Wearable Sensors and Energy Storage** **Topic C: Atomically Engineered Materials for Sustainable Carbon-Free Fuels**
4	SUMMARY: Annotation A) Microrobots are at the forefront of next-generation solutions in healthcare and environmental technologies. They are designed to: • Remove nanoplastics from aquatic environments • Eradicate biofilms that obstruct medical treatments and device performance Our group explores the innovative designs and mechanisms of nano- and microrobots, with emphasis on: • Targeted biomedical therapies and improved antibiotic efficacy • Environmental remediation through micro- and nanoplastic adsorption • Advanced single atom engineering strategies for precise functionality We seek motivated candidates interested in pioneering microrobotics research, contributing to sustainable technologies, and addressing pressing biomedical and environmental challenges. Key References: • Urso, Ussia & Pumera, Smart micro- and nanorobots for water purification, Nat. Rev. Bioeng. 2023. • Mayorga-Martinez, Zhang & Pumera, Chemical multiscale robotics for bacterial biofilm treatment, Chem. Soc. Rev. 2024. • Urso, Ussia, Novotný & Pumera, Trapping and detecting nanoplastics by MXene-derived oxide microrobots, Nat. Commun. 2022. • Pumera et al., Technology Roadmap of Micro/Nanorobots, ACS Nano 2025. Annotation B) The transition to flexible and wearable electronics demands advanced energy storage and sensing materials. Our group pioneers the development of next-generation systems that integrate: • Flexible and stretchable batteries and supercapacitors with high energy density • Wearable sensors for real-time health and environmental monitoring • 2D and MXene-based nanomaterials, conductive polymers, and hybrid architectures • 3D printing for batteries and sensors This research bridges materials science, nanotechnology, and device engineering, addressing key challenges in: • Mechanical flexibility and stability of energy storage devices • Biocompatibility and integration into wearable platforms • High sensitivity, selectivity, and durability of flexible sensors We seek motivated postdoctoral researchers eager to shape the future of smart energy and sensing technologies through materials innovation and device engineering. Annotation C) This project focuses on the design and development of next-generation electrocatalysts for the sustainable production of carbon-free fuels such as hydrogen and ammonia. By applying single-atom engineering and atomic-scale tailoring of

	catalyst surfaces, we aim to significantly enhance catalytic efficiency, selectivity, and stability. The electrocatalytic processes will be ultimately powered by renewable green energy sources, ensuring a closed, environmentally friendly fuel cycle. The research will establish a fundamental understanding of structure–property relationships at the atomic level, enabling breakthroughs in scalable, sustainable fuel generation technologies crucial for the energy transition.
5	RG WEBPAGE/CONTACT: https://www.ceitec.eu/future-energy-and-innovation/rg322