Materials discovery: The need of paradigm shift

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In the 21st century, our world is confronted with critical challenges that include climate change, energy scarcity, environmental degradation, the risks surrounding critical raw materials, and the need for sustainable development. Addressing these grand challenges requires the discovery of advanced materials, which are essential for driving technological innovations that can revolutionize the energy landscape, enhance resource efficiency, mitigate environmental impacts, and many more. However, traditional “trial-and-error” approaches to materials discovery methods is too slow, costly, and inadequate to meet the increasing complexity and technological demands of next-generation materials. For example, the prolonged development timeline of lithium-ion batteries—spanning over two decades from research to commercialization—demonstrates the inefficiency of conventional methods in delivering critical breakthroughs when they are most needed. In key applications like battery technology, where fundamental material classes have remained largely unchanged, there is an urgent need to discover lower-cost, non-toxic, environmentally sustainable, and earth-abundant advanced functional materials. In this talk, I will introduce FULL-MAP, one of our groundbreaking European project - “FULLy integrated, autonomous & chemistry agnostic Materials Acceleration Platform for sustainable batteries” - Which is a part of the visonary Battery 2030+ initative. This project aims to revolutionize the way battery materials and interfaces are discovered by leveraging cutting-edge technologies. By integrating laboratory automation with high throughput scientific experiments and seamlessly integrating essential elements for systematic, sequential experimentation, these approaches leverage AI- and machine learning (ML)- acclerated multi-scale and multi-physics modelling to enable smart decision-making. This transformative framework aims to redefine the materials discovery paradigm—enabling faster, more cost-effective, and highly targeted — ultimately driving innovations to address today’s most critical technological and societal challenges.