

Fundamentals on batteries

The threat of global warming and climate change are accelerating efforts to decarbonise our systems. In energy, battery is at the forefront of this charge. Simply put, battery technology will be part of the future.

The Fundamentals on batteries course empowers learners with the fundamental knowledge and insights to advance their understanding of battery technologies. They will fully understand the key role of batteries as the go-to tool for energy storage, together with the core components and parameters of batteries themselves. Learners will explore the chemistry and electrochemical phenomena that lie behind battery operation and a concise view of the different currently available battery technologies. Lastly, they will get a peek at the principal and emerging technologies that are poised to reshape the energy panorama.

Learning outcomes

This course empowers learners to:

- Summarise current battery technologies in terms of working principles and main characteristics.
- Understand the limitations of each technology based on their working principles.
- Predict the most suitable applications for each battery technology.
- Reflect on the challenges that each battery technology faces.
- Evaluate emerging, cutting-edge battery technologies and their potential applications.

Course structure and content

Fundamentals on batteries is an online course and can be taken at the learners' usual study location. The course consists of four modules. Each module includes reading materials and animations to illustrate the content.

- **Module 1:** Discovering the added-value of batteries in both our daily life and in the development of a low-carbon modern society. The experts will provide learners with key knowledge for a deeper understanding of battery technology. Learners will take a look inside a battery to understand its basic operation and main components and they will learn to classify battery technologies.
- **Module 2:** Exploring the phenomena that occur within a battery during operation and providing learners with in-depth knowledge on the thermodynamic aspects of battery operation and relate them with the common battery parameters.
- **Module 3:** Investigating different battery technologies and learning to explain the key characteristics and main applications of eight currently available technologies, starting with the widely used lithium-ion batteries present in most electronic devices.
- **Module 4:** Taking a peek at the future and exploring two important emerging battery technologies: metal-air batteries and solid-state batteries, to understand the potential and challenges behind these cutting-edge technologies.

Who are the experts?

Fátima Montemor

Full professor at the Department of Chemical Engineering, a researcher at CQE, and Vice President of Instituto Superior Técnico. Her scientific interests include the development of functional surface coatings for multipurpose applications in different fields such as surface protection and energy conversion and storage

Jean-Luc Delplancke

Scientific co-worker at the Université Libre de Bruxelles (ULB) in Belgium and Honorary Professor at the University of Birmingham. Jean-Luc has also worked in the European Commission (EC) where he was Head of the Program Unit for the Fuel Cells and Hydrogen Joint Undertaking up to 2016

Jorge Varela Barreras

Senior researcher at Imperial College London in the Department of Mechanical Engineering, where he works on batteries and battery management systems

Maarten Mees

R&D team leader in Electrochemical Storage at IMEC. Maarten has completed research and research education in physics at KU Leuven while having master level studies in Electrical Engineering also at KU Leuven. Maarten is focused on developing the next generation of solid-state batteries, with an interest in ALD technology and the development of novel nanomaterials for the cause.

Target audience

This course is beneficial for anyone interested in developing their knowledge of battery storage fundamentals and electrochemical phenomena as well as current and emerging battery storage technologies. In order to be able to follow and benefit from the Fundamentals on batteries course learners would need to have a basic knowledge of chemistry, math, physics, and electrical systems.

Course evaluation

To succeed in the Fundamentals on Batteries course and receive a Certificate of Accomplishment, a learner needs to obtain a minimum score of 75 points in the general assessment. This general assessment serves as a test on the understanding of the course content by each learner. In-lesson quizzes are only meant for self-evaluation and do not count towards the final Certificate.