IRONFlow

Acronym and title	IRONFlow "Neutral, all-soluble iron-based redox flow batteries for stationary energy storage"
Project number	2022.04589.PTDC
Start and conclusion date	1/01/2023 to 31/12/2026
VG CoLAB total budget	€ 147 199.29
Main goal	Development of an effective and sustainable Fe-based RFB.
Partners	FEUP
Expected results	A Fe-based RFB with an energy density in the range of 25-35 $Wh{\cdot}L^{-1}$, aiming at Coulombic efficiencies of 99-100% with 98-100% of capacity retention per cycle and current densities between 100-150 $mA{\cdot}cm^{-2}$ over a considerable cycling period.
Summary	In the last few decades, environmental concerns have been brought on by the ever-increasing emission of greenhouse gases, which have been tackled by the implementation of large-scale renewable energy sources, mostly solar and wind power. However, due to the intermittent nature of these sources, the implementation of reliable energy storage systems is vital. Aqueous redox flow batteries (ARFBs) are attractive for stationary energy storage, due to increased safety, decoupled power and capacity, and prolonged service life. Most of the established ARFB, are based on vanadium and associated to low energy densities (≤ 25 Wh·L-1) with a significant environmental impact resulted from V use. Therefore, there is a critical need for the development of new environmentally friendly, and safe electrolytes for ARFBs. Iron-based chemistries have attracted significant attention due to the eco-friendliness, vast availability, and low cost of Fe. However, one of the main issues associated to Fe-based redox flow batteries (IRFBs) is the significant crossover of active species through the membrane, leading to permanent battery capacity loss. The possible concerns related to the dendrite formation (promoted by deposition/dissolution mechanisms of metallic Fe), can be avoided using Fe-based complexes, such as Fe(TEA), Fe(EDTA), or Fe(DIPSO). Although the inherent stability of these complexes in acidic or alkaline media, focus will be given to species stable in near neutral to neutral aqueous media. IRONFLOW will aim at the use of Fe complexes in mild electrolyte conditions, avoiding handling and disposal of highly acidic and alkaline electrolytes. The solubility and stability of these complexes will be optimized for increase of battery capacity and the development of efficient, environmentally friendly Fe-based RFBs, through a deep optimization of ARFB positive and negative electrolytes by different methodologies. IRONFLOW will also focus on complementary optimization procedures for the RFB cell, as a complete system, envisioning the application of mild electrolytes. Conventional VRFB configuration will be used as benchmark for the evaluation of IRONFLOW prototype performance metrics.