

Diagnostics and characterization of hydrogen technology devices

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Considering the limited natural energy reserves and environmental pollution, our current energy system is unsustainable. Thus, gradual abandonment of fossil fuel technologies is inevitable. The future definitely belongs to renewable energy sources (RES) and transition from the use of natural energy reserves to the use of natural energy flows. However, there are still many challenges, such as intermittent and variable availability, variable intensity, frequent mismatch of energy needs with production, etc. Promising and environmentally friendly solution in the current energy transition to the future sustainable energy system, without jeopardizing our current technological development and way of life, could be the widespread use of (green) hydrogen^{1,2} as an energy carrier in the system in conjunction with RES, and the use of hydrogen technology devices. This presentation will contain an overview of hydrogen-based electrochemical energy conversion devices, which include the proton exchange or polymer electrolyte membranes (PEM), such as PEM fuel cells³⁻⁶, PEM electrolyzers⁷ and electrochemical hydrogen compressors⁸. Their current technology shortcomings and challenges, primarily considering durability, will be briefly discussed. The main focus will be given on recent achievements and advances in their state-of-health monitoring and performance diagnostics within our Laboratory for New Energy Technologies at FESB, University of Split, under the several ongoing research projects and collaborations. Additionally, attention will also be on presenting our research capabilities and potential development ideas for further collaborations. All the results obtained so far should assist in further research and development of more practical operando diagnostic and prognostic tools for a better understanding of the complex processes within hydrogen technology devices at the cell and stack level, and their more efficient way of control and management in practice.

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