TECHNICAL UNIVERSITY OF KOŠICE
Faculty of Mechanical Engineering

HORIZON-CL5-2023-D5-01-07: Hydrogen-powered aviation

Ideas for the project:
Faculty of Mechanical Engineering on TUKE has been focused on the development and research of hydrogen technologies for more than 16 years. We focus on the development and testing of new metal hydride (MH) materials, heat transfer during cryogenic storage of hydrogen, as well as stress calculations for high-pressure tanks. We are able to implement metal hydride materials into MH compressors for safe compression of hydrogen, transport equipment (buses, forklifts, ships,...). At the same time, we are conducting research on the separation of hydrogen from synthesis gases. We base the design of prototypes on numerical methods of heat transfer, fluid flow and gas absorption.

Our ideas for the project:
We are looking for new possibilities for the application of metal hydride materials for temporary low-pressure storage of hydrogen for subsequent use in land and air transport. Hydrogen produced from alternative energy sources using high-pressure electrolyzers can be stored directly in MH materials without the use of a compressor. Hydrogen can be supplied to mobile devices by subsequent desorption. Research into new high-entropy alloys for hydrogen storage enables the use of MH materials directly for hydrogen storage in air transport. We can contribute with strength, thermal and CFD calculations, which are an essential part of the correct design of prototype hydrogen devices.

Previous solutions: We created our own MH storage tanks with a heat exchanger in accordance with the EN 13322 standard (TRL9), which are installed in the first hydrogen bus with low-pressure technology in Europe (TRL8). We have created a hydrogen metal hydride heat pump compressor (TRL 4), that allows hydrogen to be safely compressed using chemical sorption at variable temperatures.

Experience and infrastructure offered:
1. Active work with hydrogen, design of hydrogen circuits according to EC79, valid for mobile hydrogen applications.
2. Testing of MH alloys in the temperature range -196°C to +400°C and pressure 1 to 50 bar.
3. Design and production of the low-pressure MH tanks.
4. Installation of hydrogen storage systems.

Projects solved, related to the issue:
1. Grant project APVV-15-0202 "Development of equipment for efficient compression and storage of hydrogen using new metal hydride alloys", 2016 – 2019, €244,886
2. Grant project APVV-20-0205 "Research and development of new high-entropy alloys designed for efficient storage of hydrogen in energy applications", 2021 – 2024, €249,984
3. Grant project APVV-21-0274 "Research and development of a prototype low-pressure refuelling station for supplying metal hydride devices with green hydrogen", 2022 - 2025, €249,944
4. Grant project VEGA 1/0532/22 "Research and development of energy and structural elements of hydrogen storage for mobile applications", 2022 – 2024, €45,825
5. Grant project VEGA 1/0626/20 "Research into the possibilities of reducing the energy demand of the cooling process of metal hydride storage tanks during the absorption of hydrogen storage", 2020 – 2022, €49,000

Partners in previous research projects:
BME University Budapest Hungary; DLR, Institut fur Fahrzeugkonzepte, Stuttgart, DE

Contacts to industrial partners:
Rosero-P, manufacturer of H2 buses in Slovakia; Matador Group, Slovakia

Contact:
prof. Ing. Tomáš Brestovič, PhD.
Department of Power Engineering
Faculty of Mechanical Engineering, Technical University of Košice, Slovakia
Phone: +421908377567
E-mail: tomas.brestovic@tuke.sk