

Mechanical and non-mechanical hydrogen compressors

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Hydrogen is expected to play an important role as energy vector in the next decades. Compression is essential for hydrogen storage and delivery due to its low volumetric energy density, 0.01079 MJ/L at standard conditions, the lowest one among the commonly used fuels. For this purpose, both mechanical and non-mechanical compressors are used. Mechanical compressors are preferred when high discharge pressures and flow rates are required. In particular, innovative ionic liquid hydrogen compressors seem to be a very promising solution in the development of hydrogen refuelling stations in the frame of automotive applications, since they allow compressing hydrogen up to 100 MPa through a system with a few moving units only. Among non-mechanical ones, only cryogenic compressors reach gravimetric and volumetric energy densities close to the DOE 2017 targets, whereas electrochemical compressors reach compression efficiencies up to 95%. Finally, the thermally-driven compressors, i.e. metal hydride and adsorption types, exhibit a very simple configuration reaching more than 70 MPa. I will present: (i) the basic operating principles and the performances potentially achievable for each compression technology; (ii) their current uses in hydrogen applications, as well as their technological limits, outlining the possible actions to be taken for improving their performances.

