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Project titel:	Plug&Sense - Functionalization of fiber composite pressure vessels for hydrogen storage using monofilament sensors and intelligent valve concept for damage detection and structural health assessment
Partners:	Anleg GmbHd Globiz Co. Ltd. Korea Textile Development Institute
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Mission Statement

Fuel cell electric vehicles (FCEVs), along with battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs), emit no pollutants while driving. These zero-emission powertrains are expected to play an important role in decarbonizing the transportation sector. FCEVs have the following advantages over other electric vehicles and vehicles with regular internal combustion engines (ICEVs): Hydrogen has a high mass-based energy density; Range and refueling time are comparable to ICEVs; Hydrogen refueling stations are more cost and resource efficient than electric charging stations. The most advanced hydrogen storage technology used in FCEVs is physical hydrogen storage at 70 MPa in all-composite pressure vessel systems. The operational reliability of the hydrogen storage system is critical due to the highly stressed condition of the pressure vessel's load-bearing composite laminate combined with the hazard of compressed hydrogen gas. Maintenance costs of FCEVs currently account for 5 - 17% of the total cost of ownership (TCO). To enable widespread adoption of hydrogen-powered mobility, maintenance costs should be reduced while ensuring operational safety. This could be achieved by a condition-based maintenance strategy of the pressure vessels using structural condition monitoring. The main objective of the Plug&Sense project is to develop and validate a concept for the instrumentation of composite pressure vessels for mobile applications, based on a low-cost sensor technology and an innovative intelligent valve concept for damage detection and structural condition assessment.

Approach

Within the project two approaches for the fabrication of the sensor filaments are pursued. The two approaches are doping with conductive particles and coating with conductive material. Both sensor filament types are characterized mechanically, thermally, electrically and mechanically-electrically. The feasibility of implementing the developed monofilaments as resistance-based strain sensors in fiber-reinforced composites is then tested. Specimens of composite materials instrumented with the sensors will be tested under various loading conditions (e.g., tensile, compression, flexure, shear

tests). An innovative intelligent valve system to connect the integrated sensor to the measurement equipment is developed. Based on measurement data, a condition monitoring algorithm is developed for damage assessment and condition evaluation of composite pressure vessels for hydrogen storage in mobile applications.

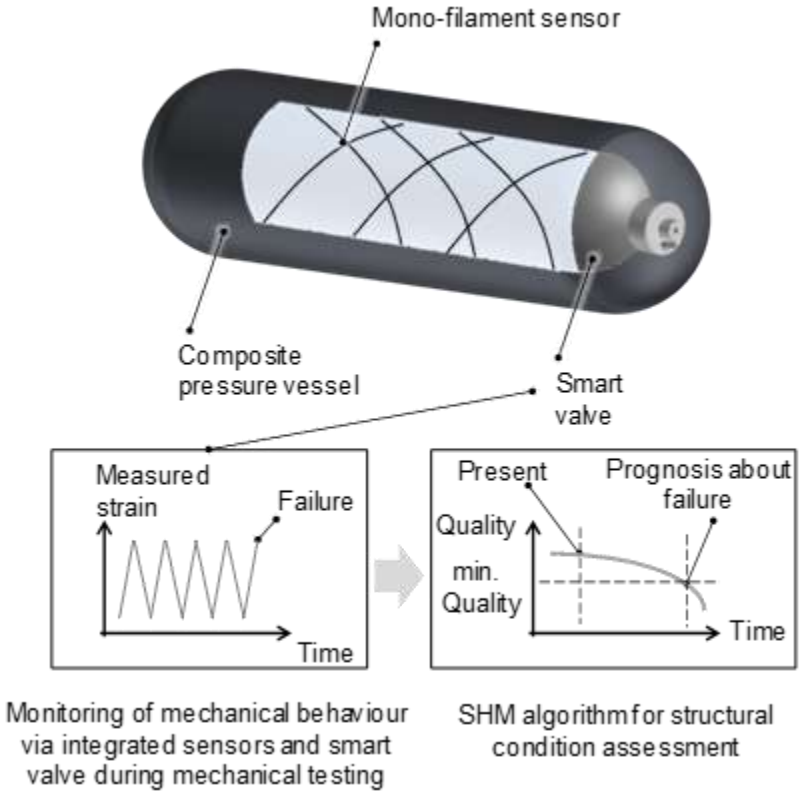

Fig.1: Concept for the instrumentation of composite pressure vessels for damage detection and condition assessment for hydrogen storage systems in mobile applications.

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