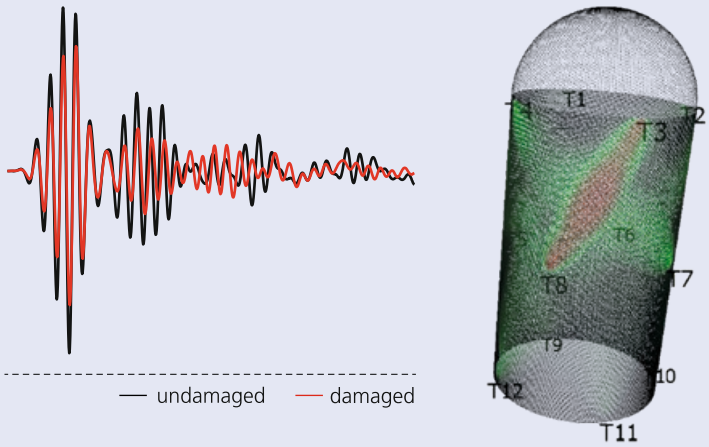
1



2

SAFE STORAGE FOR HYDROGEN AND GAS IN PRESSURE VESSELS

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Mobility for tomorrow

Various drive concepts exist for tomorrow's low-emission mobility. Among them are those using fuel cells, offering considerable advantages compared to battery-powered systems in terms of range and refueling times, which is why their development is currently being pursued by numerous automobile manufacturers. The necessary hydrogen can be produced under ecologically acceptable conditions by using renewable energy sources. The pressure vessel is the essential component for storing the liquid hydrogen in a vehicle (Figure 1).

Pressure vessels made of fiber composite material

Even in gas-powered vehicles, the standard steel tanks, which were widely used until recently, are currently being superseded by pressure tanks made of fiber-composite material (CFRP). They boast a lightweight construction as well as outstanding properties under cyclic load. The integrity of the pressure vessel must be ensured not only under cyclic loads when refueling or removing the hydrogen, but also in a damage event, e.g. in a rear-end collision. This can be assured through the permanent monitoring (termed "structural health monitoring") of the tank.

Services offered

At Fraunhofer IKTS, a monitoring and sensor system is available that can examine complex components made of fiber-reinforced composite material, such as wrapped pressure vessels, for structural changes. The monitoring system is designed and optimized on the basis of a simulation that models the measuring procedure. Extensive and complex laboratory testing can thus be simplified or even partly replaced by computer-aided investigations. Based on the results of optimization efforts, piezoelectric transducers are either integrated directly into the component during production or applied subsequently. For the measurement, actively excited ultrasound waves are applied on the component. These so-called guided waves are received passively by transducers, which are not active transmitting at that moment. These continuous or periodic pitch-catch measurements are performed on all paths between the transducers attached to the component.

In the case of a structural change, significant deviations of the measurement signals from undamaged conditions can be observed on several paths. Subsequent data analysis enables structural changes and damage to be detected, localized, classified and, finally, visualized (Figure 2).

1 *Instrumented pressure vessel made of wrapped fiber composite material, used in the automotive industry.*

2 *Recorded sensor signal of a monitoring system including visualization of a structural change.*

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