High pressure hydrogen container to promote hydrogen society

In order to promote a hydrogen society, it is important to develop a large capacity high pressure hydrogen container that supports high pressure hydrogen management. From the viewpoint of light weight and long life reliability, we have developed containers made of Carbon Fiber Reinforced Plastics (CFRP). To ensure reliability, we research on limit strength design based on multiscale simulation.

Impact damage of CFRP high pressure hydrogen container

To ensure high degree of reliability of CFRP high pressure hydrogen container for fuel cell vehicles, the series test simulating its usage environment is mandatory in GTR13. The test takes a half year, so that rational alternatives are required. We have developed an impact damage evaluation method to eliminate the drop test based on a meso-scale simulation.

Manufacturing simulator for thermoplastic CFRP

Thermoplastic CFRP is promising from the viewpoint of mass productivity. Initial defects such as residual stress and deviating fiber orientation occur due to non-uniform distribution of temperature during press molding. In order to realize high reliability in strength with prediction of the defects, we have developed a thermoplastic CFRP manufacturing simulator.

Multi filament winding method

The high pressure hydrogen container made by CFRP is manufactured by a filament winding (FW) method. In the conventional single FW method, stress concentration occurs at the crimps of the fiber bundles, and causes low strength. Therefore, we have developed a multi FW method that wraps with 100 fiber bundles at the same time without crimp. Additionally, we evaluate the mechanical superiority and develop a optimum design method by meso-scale simulation.

Modeling and shape optimization of CFRP high pressure hydrogen container

We developed a modeling software that creates mesh data generated from actual surface information of the CFRP high pressure hydrogen container. Furthermore, we derive a mathematical model of dome shape and winding path of fiber bundle, so as to construct a shape optimization algorithm.

Strength model for short fiber thermoplastic CFRP

The injection and press molding of short fiber thermoplastic CFRP is expected to contribute to cost reduction of complicated shape products. We have difficulty to predict the strength after molding, since the local volume fraction and orientation of carbon fibers are randomly distributed. We have developed a statistical strength model by means of micro-scal nonlinear fracture simulation.

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