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Development of Smart Hydrogen Storage Vessel by Using Optical Fiber Acoustic Emission Sensor

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Abstract

Hydrogen, as a new energy source, has attracted significant attention, resulting in the construction of several hydrogen stations in recent years. The acoustic emission (AE) method is employed to monitor the fatigue damage of composite pressure vessels, which are often used in these stations. However, AE monitoring using a conventional lead zirconate titanate (PZT) sensor requires several sensors to monitor the entire pressure vessel because the signals get attenuated with distance. Therefore, in this study, we developed a smart pressure vessel using an optical fiber AE sensor that is capable of monitoring a wide area, instead of only the hoop layer of the pressure vessel. The sensitivity of the developed smart pressure vessel was, first, evaluated by an artificial AE source using a pencil lead breaking. As a result, the sensor could detect weak AE signals produced by this source. In addition, the pencil lead breaking method was used on a hydrogen pressure vessel in which multiple half-wavelength optical fibers (for wave propagation through the hydrogen pressure vessel) device were installed. As a result, the signal remained stable even if the position of the core pressure contact had changed.

Keywords*:* Composite vessel, Acoustic Emission, Optical fiber sensor, Smart Vessel