Wireless self-powered ammonia leakage monitor system developed for ammonia-energy ships

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Due to its zero carbon, safe storage, and high energy density, liquid ammonia is a promising marine fuel in the shipping industry.

However, ammonia is a common toxic gas that can cause irritation to the mucous membranes and respiratory system. Therefore, it's necessary to develop a real-time and accurate ammonia monitoring method for long-

distance sea voyages.

Recently, a research group led by Prof. Feng Liang from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS), in collaboration with Prof. Xu Minyi's group from Dalian Maritime University, developed a full-set wireless self-powered ammonia leakage monitor system for ammonia-energy ships.

The system includes a honeycomb triboelectric nanogenerator (TENG)-based power generation system, a carbon nanotube doped polypyrrole (CNTs-PPy)-based ammonia detection system, and a signal collecting and transmitting system (Bluetooth).

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The researchers improved the electronic conduction efficiency via the synergistic effect between the carbon nanotubes and conductive polymers, which enhanced the sensing performance at room temperature. The sensor exhibited good performance with a low detection limit, short response time (about 90 s), high selectivity, good stability, and low cost.

Moreover, by using Bluetooth, the researchers realized wireless transmission from the detection module to the computer terminal.

By combining with the honeycomb structure TENG provided by Dalian Maritime University, the system could collect and covert the mechanical energy generated by the vibration of the ship's engine into electrical energy, realizing self-powering of the entire sensing system.

The researchers tested the system on the expedition ship. The entire sensing system worked smoothly in the low-level cabin of the ship with high temperature and high humidity, confirming its potential in practical

applications.

"The self-powered wireless detection system can realize long-term maintenance-free monitoring of ammonia leakage during ocean voyages," said Prof. Feng. "It is expected to play an important role in the further application and promotion of ammonia energy."

More information: Junyu Chang et al, A full-set and self-powered ammonia leakage monitor system based on CNTs-PPy and triboelectric nanogenerator for zero-carbon vessels, *Nano Energy* (2022). DOI: 10.1016/j.nanoen.2022.107271

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