Novel Ammonia Production Method Using Both Microbubbles and Iron Electrodes for Seawater Electrolysis

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Recently, ammonia (NH3) has been attracting attention as a renewable energy carrier worldwide. The conventional method of producing NH3 requires high temperatures and pressures that cannot be consistently maintained using renewable energy sources due to the influence of environmental conditions such as the weather. Although an NH3 production method using microbubbles (MBs) has been developed at our school, it lacks the high generation rate required for practical use. The NH3 generation rate achieved using the abovementioned method increased 200 times after conducting electrolysis using an NaCl solution and iron electrodes. This is mostly because ferric hydroxide (III) colloidal particles transport the MBs to the vicinity of the electrodes, thereby leading to the collapse of the MBs and rapid increases in pH and surface tension, resulting in the acceleration of NH3 generation. After verifying the proposed mechanism, NH3 generation was optimized, and various iron nitrides were produced using a 6–15% (w/v) NaCl solution with a pH of ≥12, an electric current of ≥0.3 A, and N2 flow rate of ≥1 L/min. The study findings demonstrate that high-efficiency NH3 generation from renewable energy is achievable via an ammonia production device embedded with an iron multi-electrode system, where cathodes and anodes are periodically reversed, converting nitriding iron to NH3.

Awards Won:

Shanghai Youth Science Education Society : Science Seed Award