H_2 Generation by Rotational Gliding Arc Plasma from Ammonia Decomposition

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Highlights

- H_2 production was performed in gliding arc plasma
- 2.9% of H_2 was achieved at a specific energy input of 2.85 kJ/L.
- The temperature of the reactor was below 100 °C

1. Introduction

Hydrogen (H_2) emerges as a beacon of hope in the realm of energy, offering a promising and eco-friendly alternative to fossil fuels. Despite its potential, the journey towards widespread adoption faces formidable challenges, particularly in the realms of storage and transportation [1]. This is chiefly due to hydrogen's paradoxical nature – possessing a high energy content per unit mass yet a low volumetric energy density [2]. The viability of using ammonia as a chemical energy storage medium hinges on the availability of an efficient, rapid, and cost-effective decomposition method. Among the potential solutions, non-equilibrium gliding arc discharge (GD) plasma emerges as a promising candidate. An essential consideration in the decomposition of ammonia, particularly at low concentrations, is the substitution of nitrogen for argon in the reactor's gas inlet. This adjustment facilitates the generation of a discharge with increased power, leading to higher levels of ammonia conversion. By optimizing this process parameter, researchers aim to enhance the practicality and effectiveness of utilizing ammonia for energy storage applications. Through such advancements, the potential of ammonia as a sustainable and scalable energy carrier could be further realized, contributing to the transition towards a cleaner and more efficient energy landscape[3].

This research aims to explore the complex interactions among various factors that influence the effectiveness of producing hydrogen through the decomposition of NH_3 using GAD plasma in ambient settings. It seeks to understand how variables like the concentration of NH_3 and the amount of applied power affect the overall efficiency of the process. The study involves a thorough examination of these variables to gain insights into their individual and collective impacts on hydrogen production. By scrutinizing NH_3 concentration and applied power meticulously, the research aims to uncover the nuances of their influence on the efficiency of the hydrogen production process. Ultimately, the findings of this research could contribute to enhancing the efficiency and effectiveness of hydrogen production using GAD plasma technology.

2. Methods

In this research, iGC7200 is used to detect hydrogen, ammonia, and nitrogen gases. Moreover, Figure 1 shows the experimental setup used.

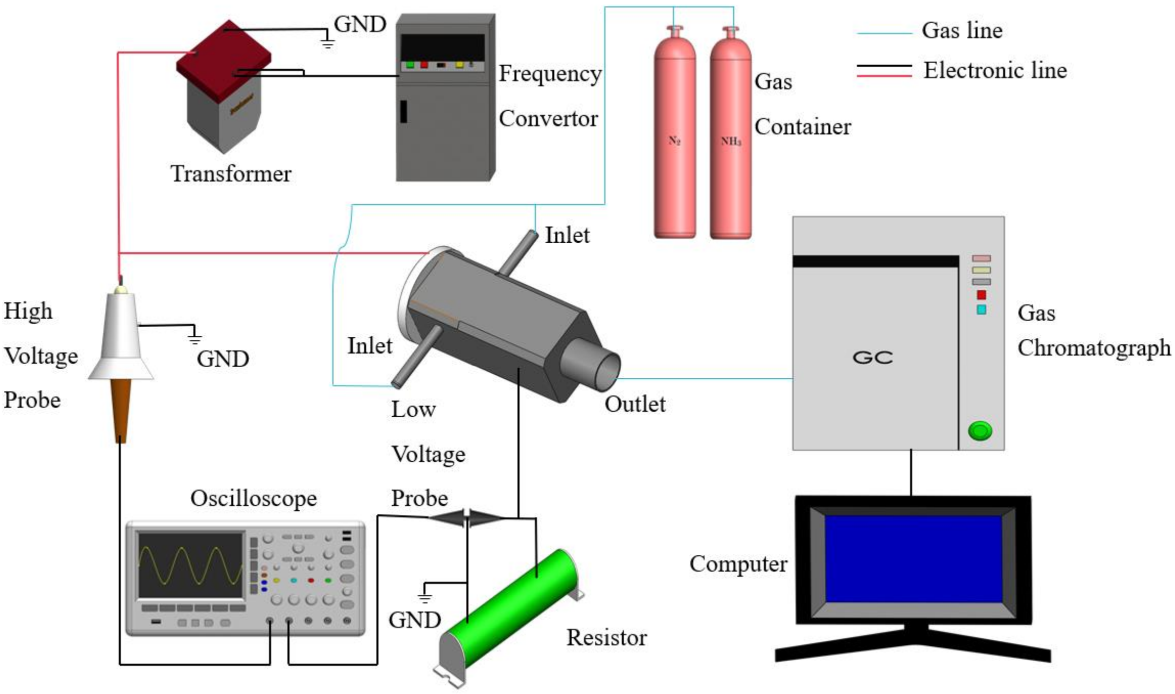

Figure 1: Experimental Setup

3. Results and discussion

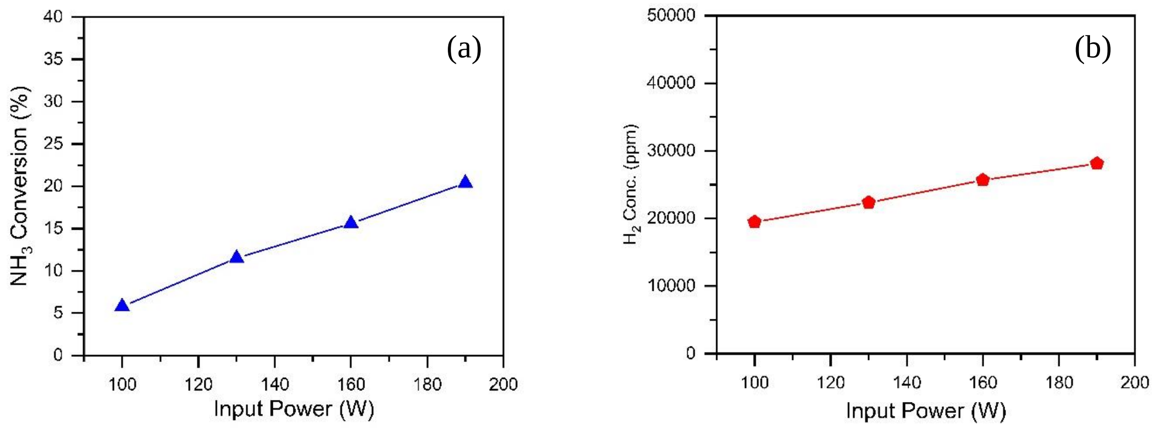

Figure 2: NH_3 conversion (a) and H_2 concentration (b) with total Flow rate 4L/min (NH_3 = 12.5%)

4. Conclusions

In this study, hydrogen without CO_x was produced via gliding arc plasma discharge with a flow rate of 4 L/min from the decomposition of ammonia.

References

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Keywords
Hydrogen Production, Ammonia Decomposition, Plasma.