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The Design of Low Energy Nuclear Battery

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Abstract

This study presents a new battery design that harnesses the potential of low energy nuclear reactions (LENR) as a clean and efficient energy source. Rather than solely focusing on maximizing LENR's heat generation capabilities, our goal is to integrate it into a battery that offers higher energy density, longer lifetimes, and lower costs compared to existing battery technologies. To achieve this, we propose using hydrogen gas as fuel and incorporating graphene and terahertz (THz) into the design. Specifically, we plan to create p-n junction plates made from materials such as silicon carbide (SiC) or gallium nitride (GaN) and place them under a graphene sheet to generate an electrical current through the electron-beam-induced effect. Our innovative approach to battery engineering has the potential to revolutionize the way we store and use energy, by providing a sustainable and affordable solution to power our world without harmful emissions.

Keywords: Low energy nuclear battery (LENB), plasmonic graphene, terahertz

1. INTRODUCTION

For decades, LENR has been the subject of experiments and discussions as a heat excess phenomenon without a well-established theoretical framework. Beta decay has long been considered as one of the primary explanations for how such an excess heat could be generated, with evidence of residue products observed. Therefore, if we can capture those scattering electrons directly as electricity, we might be able to construct a battery.

Recently, significant advances have been made in our understanding of the exceptional properties of graphene, including the generation of plasmons in response to excitation in the THz frequency range.

According to the theory proposed in this paper, protons on plasmonic graphene should convert into neutrons upon collision with electrons in a plasmonic state. If they do not collide, plasmonic electrons will absorb the kinetic energy of the protons due to their stopping power.

At the ICCF25 conference, Xing-Zhong Li presented the $A^{1/3}$ – Law, which suggests that the K-electrons captured by protons may facilitate the process of LENR [1]. By replacing the K-electron capture with plasmonic electron capture, we can still expect that excited protons on plasmonic graphene will create conditions conducive to LENR. This paper aims to explore these concepts further and examine their potential for practical application.

2. Theory and Core Design

The materials for the low energy nuclear battery (LENB), hydrogen and carbon, are expected to have weak interactions according to Xing-Zhong Li et al.'s the $A^{1/3}$ – Law. Therefore, we must observe beta decays emitting electrons through proton-proton chain reaction (p-p cycle) and carbon-nitrogen-oxygen cycle (CNO cycle) without emitting gamma rays and neutrons. At low energies, it is expected that neutralized protons would undergo neutron-neutron fusion (n-n fusion) more frequently. We consider the n-n fusion reaction $n + n \rightarrow d + e^- + \bar{\nu}_e$, for neutrons of low energies. The maximum energy of the outgoing electron is estimated to 3.52 MeV [2]. In addition, proton captures during these cycles are more likely to results in neutron captures. Therefore, the energy products from these cycles consist primarily of electrons and neutrinos.

While electron emission by beta decays could act as a negative electrode on its own, we choose to place p-n junction plates such as SiC or GaN under a graphene sheet to generate an electrical current through an electron-beam-induced effect.

The core design of LENB is illustrated in Fig 1. Our proposed approach involves exposing the graphene sheet to THz waves, which will stimulate the plasmons present on the graphene surface. The goal is to avoid introducing any additional materials that could convert the beta decay into heat. Instead, we propose supplying controllable external heat to contribute to the formation of plasmons while also promoting p-p and CNO cycles. By carefully regulating the amount and timing of the external heat, we aim to achieve efficient conversion of thermal energy into electrical energy via the electron-beam-induced effect. Overall, our design is intended to maximize the yield of electricity from the LENB while minimizing waste heat production.

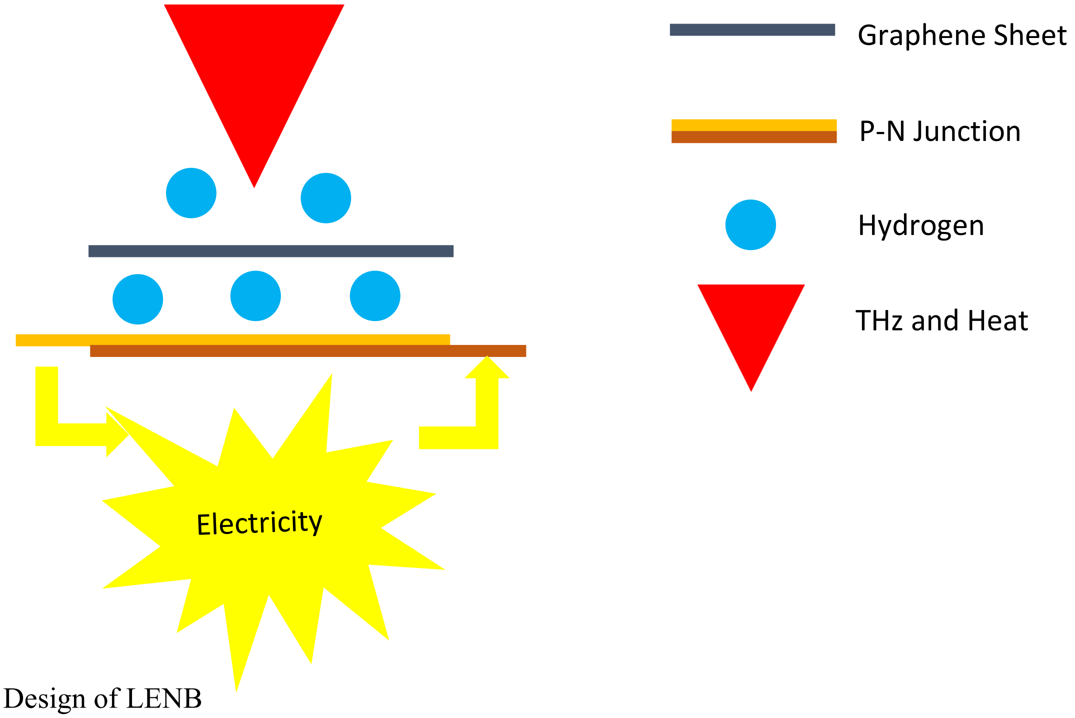

Fig 1. Core Design of LENB

3. Experimental

3.1. Experimental setup

A schematic of the experimental setup is shown in Fig 2. At this stage, the device is still in the planning stages, but the basic design is similar to a common LENR device [3], except that it produces electricity[1]. The chamber has two ports for introducing and evacuating gas, which are monitored by a gauge. The chamber can be evacuated using a turbo molecular pump, and gamma-rays will be monitored during the experiment for safety reasons. A THz source is positioned above the chamber targeting the graphene surface. The THz and heater input powers are supplied by power sources operating in constant voltage mode, while the voltage and current of the input and output signals are measured by both voltage and current monitors.

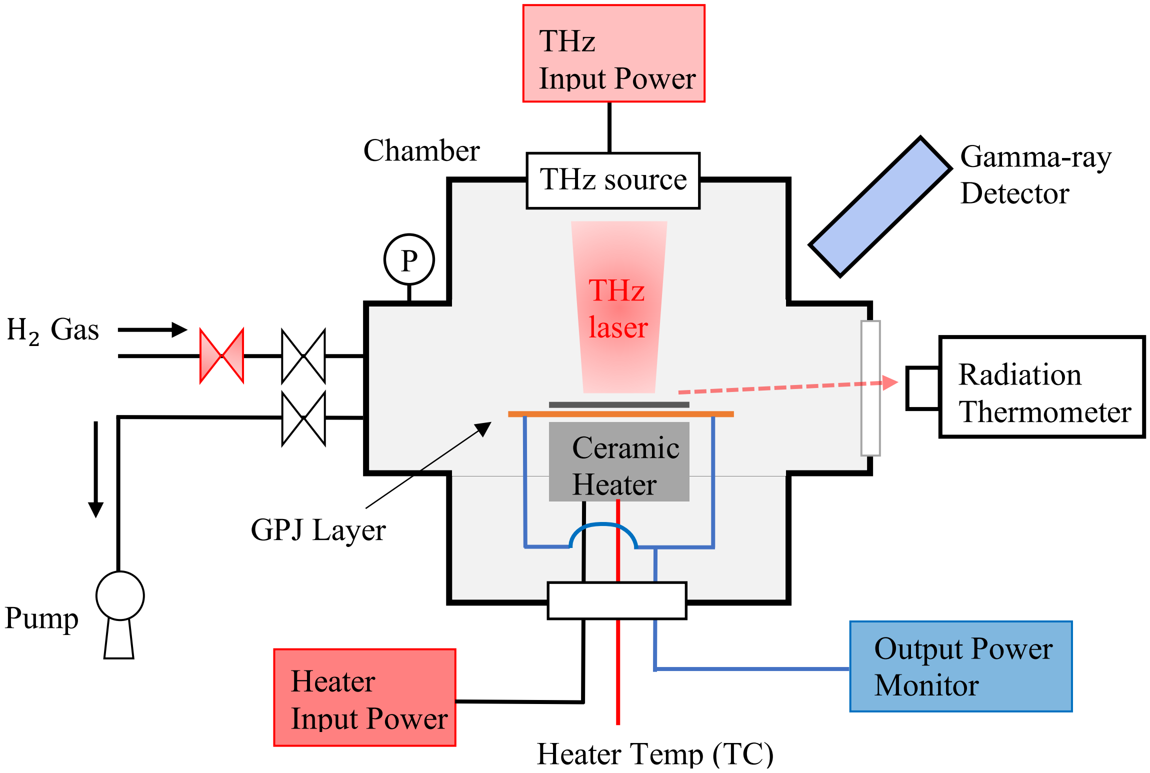

Fig 2. Schematic of the experimental setup

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[1] Electricity production comes in packages from certain ongoing projects, such as the E-Cat by the Leonardo Corporation (http://ecat.com) and the EnergiCell by the ENG8 International Limited (http://eng8.energy).

3.2 Experimental procedures

The experimental procedure involves placing the GPJ layer composite in the chamber. After evacuating the air inside the chamber and sealing it, H_2 gas is introduced, and the GPJ layer is heated by the ceramic heater, causing plasmons to be excited on the graphene surface through THz irradiation. This process generates beta decays, and we expect to observe power output on the monitor connected to the p-n junction.

To ensure safe and efficient operation, gamma-ray monitoring and turbo molecular pump evacuation will be used during the experiment. The THz and heater input powers are controlled by constant voltage power sources, while the voltage and current of the input and output signals are measured continuously.

4. Discussions

Since this experimental design for LENR is novel and lacks quantitative data analysis, it is important to begin with initial parameters that are as low and small as possible. To start, we recommend using lower pressure gas loading, lower temperatures, and smaller GPJ sizes. By gathering a substantial amount of data, we can estimate the potential for large-scale power output and then modify the setup accordingly by trying multi-layer GPJs, higher temperatures, and pressures.

5. Conclusions

In this paper, we presented a conceptual design for a battery utilizing LENR. While more detailed preparations are necessary before conducting the first experiment, the potential energy output from this technology makes it a promising alternative energy source for the future. Once we are able to measure the power output and determine its feasibility as a reliable energy resource, it could lead to major advancements in energy production and potentially change the way we power our lives.

References

[1] X. Z. Li, C. L. Liang, G. S. Huang, S. X. Zheng, B. Liu, J. Tian, S. Chen, Y. Chen and Z. M. Dong, $A^{1/3}$ - Law in nuclear transmutation of metal hydrides (II), *Abstracts of 25th International Conference on Condensed Matter Nuclear Science* (2023) 44
[2] S. Ando and K. Kubodera, Neutron-neutron fusion, *Phys. Lett. B* 633 (2006) 253-259
[3] Y. Iwamura, T. Itoh and J. Kasagi, Excess Energy Generation using a Nano-sized Multilayer Metal Composite and Hydrogen Gas, *J. Condensed Matter Nucl. Sci.* 33 (2020) 1-13