The Design of a Low-Energy Nuclear Battery

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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 the heat generation capabilities of LENR, our goal is to integrate it into a battery that offers higher energy density, longer lifetimes, and lower costs than existing battery technologies. To achieve this, we propose using hydrogen gas as the fuel and incorporating graphene and a terahertz (THz) source 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 to place them under a graphene sheet (GPJ layer) to generate an electrical current through an electron-beam-induced effect.

The materials for the low-energy nuclear battery (LENB), hydrogen and carbon, are expected to have weak interactions according to the assumption that protons are neutralized by electron capture prior to undergoing fusion [1][2]. Therefore, we expect to observe beta decay processes that emit electrons through proton-proton chain reactions (p-p chain) in plasmons excited by THz on the surface of graphene. At low energies, neutralized protons are expected to undergo neutron-neutron fusion (n-n fusion) more frequently. We consider the n-n fusion reaction $n + n \to d + e^- + \bar{\nu}_e$ for neutrons of low energies. The maximum energy of the outgoing electron is estimated to be 3.52 MeV [3]. In addition, proton captures during p-p chain are more likely to result in neutron captures.

At this stage, a schematic of the experimental setup is shown and the device is still in the planning stages, but the basic design is similar to that of a common LENR device [4], except that it produces electricity.

Keywords: Low-energy nuclear reaction, Low-energy nuclear battery, H_2 gas, Graphene, Terahertz, Plasmon, Electron capture, Neutron capture, SiC, GaN

1. Introduction

Since two electrochemists, Fleischmann and Pons, announced their electrolysis experiment with palladium and deuterium generating nuclear energy in the form of heat in 1989 [5], research on LENR has been conducted by numerous experts around the world for over 30 years. Although LENR has not yet gained widespread acceptance in the scientific community, there have been significant developments in recent years that suggest it may offer a solution to our energy crisis, which is being exacerbated by the effects of climate change. In 2022, the US Department of Energy began funding LENR projects as part of its Exploratory Topics program. Several academic institutions are now conducting LENR research thanks to this funding [6].

Our paper challenges the current understanding of the developmental stages of LENR, particularly in regard to quantitative reproducibility and theoretical foundations. As such, our focus is on developing a hypothesis-driven experiment that can effectively create a LENB. Our ultimate goal is to find the most efficient method for directly extracting electrical energy from LENR reactions.

2. Core Design of the LENB

LENBs, represent a new type of battery technology that uses nuclear fusion reactions to generate power. Unlike traditional nuclear reactors, which generate heat, the

LENB extracts electricity directly from the fusion reaction using hydrogen gas as a fuel. The core design of LENB is illustrated in Fig 1. To enhance the LENB's performance, we use graphene sheets and P-N junctions made from materials such as silicon carbide or gallium nitride to form power semiconductor devices, which are used along with a THz source operating at approximately 1–10 THz. By miniaturizing and simplifying these essential components for operation on the nanoscale, we improve device efficiency while also ensuring greater safety. In addition, by incorporating the latest advancements in materials science, we can then push the boundaries of what was once thought to be impossible.

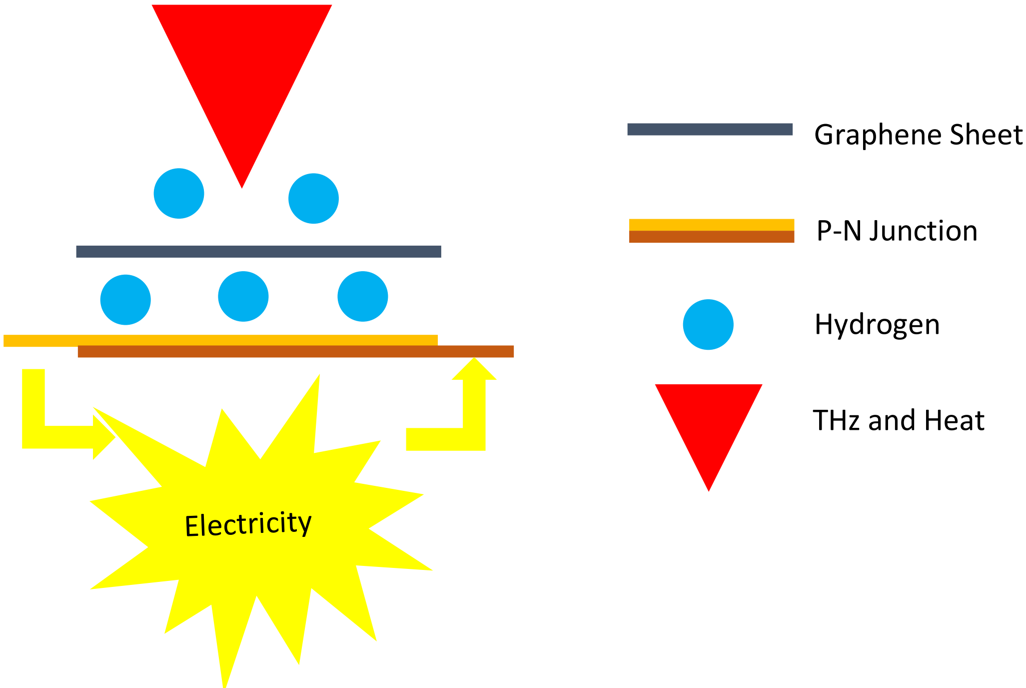

Fig 1. Core Design of LENB

3. Experimental Setup (Plan)

A schematic of the experimental setup is shown in Fig 2. Our initial objective in the experiments is to determine whether the reaction will generate sufficient electrical power. Before beginning our experiment, we will not perform any pretreatment of the core. Instead, we will expose it to vacuum conditions while simultaneously introducing the gas. The reaction site of LENB is located on the surface of graphene, which allows for the evaluation of the reaction performance primarily through electrical output rather than thermal or byproduct formation.

We will then manipulate three critical factors: the core temperature, the THz frequency, and the gas pressure. The core temperature can be set lower than typical values for LENRs, which are estimated to be around 100–300°C. This is because the THz radiation peak for different materials commonly occurs within this range. The p-n junction ideally breaks above certain temperatures to function as a circuit breaker within the primal energy loop, safeguarding the entire device, particularly during its initial experimental stage. It is advisable to observe a small amount of current due to plasma excitation on THz radiation in the absence of any gases, so that we can consider it as the initial state. Before conducting any experiments involving gas loading, it is crucial to meticulously set up the experimental apparatus to optimize the reaction site. This may entail adjusting several components of the device to establish optimal conditions for the desired LENR. Upon preparation, we can then proceed with the gas loading process into the chamber. Based on our estimation, we believe there to be a proportional relationship between gas pressure and electric generation, taking into account the simple reaction rate. However, as the reaction site has not been studied in sufficient detail, we must exercise caution when increasing the gas pressure and conduct our experiments gradually.

In order to gain a deeper understanding of LENR, we plan to conduct experiments using microscopic-scale materials. By exciting plasmons on graphene sheets using THz radiation, we can observe a static pattern on the nanoscale. At this size scale, these particles exhibit behavior that is more reminiscent of classical particles, making it easier for us to study their properties.

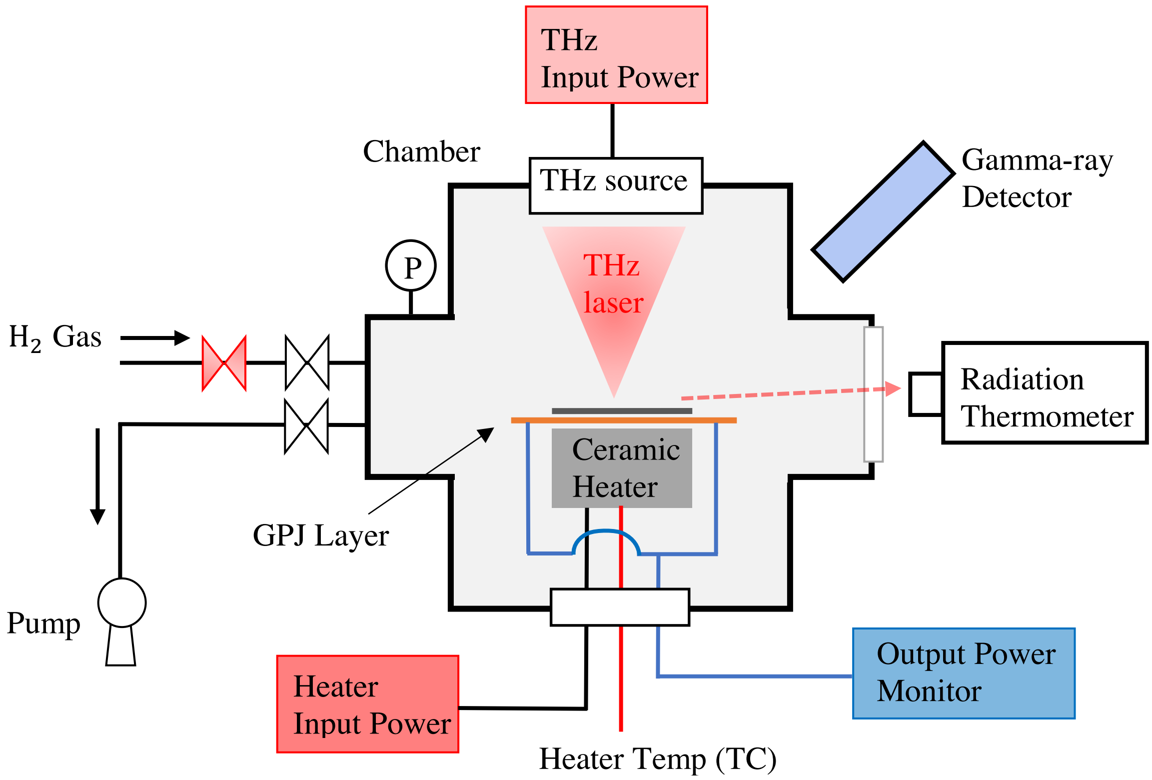

Fig 2. Schematic of the experimental setup

4. Theoretical Assumptions

Here we discuss the theoretical assumptions about the low-energy nuclear reactions. In the first stage, THz irradiation creates plasmons on the surface of the graphene. As a result, hydrogen atoms are condensed within these plasmons. In the plasmons, protons capture electrons and turn into neutrons. Then, these ultra-low momentum neutrons fuse with protons or with each other. As a result of this process, we assume that one of the neutrons will emit an electron through beta decay. The emission of electrons will then generate electricity on a P-N junction via an electron-beam-induced effect.

In addition, a low-energy proton-proton or LEPP chain reaction may also occur. The LEPP chain reaction is a significant and desirable reaction that occurs on the graphene surface. This reaction process involves four steps:

1) $\mathrm{p} + \mathrm{e}^- \rightarrow \mathrm{n} + \nu_\mathrm{e}$; electron capture
2) $\mathrm{p} + \mathrm{n} \rightarrow \mathrm{d} + \nu_\mathrm{e}$; $\mathrm{n} + \mathrm{n} = \mathrm{d} + \mathrm{e}^- + \bar{\nu}_\mathrm{e}$; deuterium production
3) $\mathrm{d} + \mathrm{n} \rightarrow {}^3\mathrm{He} + \mathrm{e}^- + \bar{\nu}_\mathrm{e}$; helium-3 production
4) ${}^3\mathrm{He} + \mathrm{n} \rightarrow {}^4\mathrm{He} + \nu_\mathrm{e}$; helium-4 production

In the first step, protons undergo electron capture. Then, the second and third steps lead to the occurrence of neutron capture through beta decay. This process differs from the proton-proton chain reaction that occurs in hot fusion.

From the author’s perspective, the mass deficit that is observed in the latter three steps can be explained by the conversion of that mass into massless particles known as gravitons [7]. These particles are believed to carry kinetic energy, which they can then transfer to particles with mass through collisions. When gravitons collide with charged particles, they can emit electromagnetic radiation such as gamma rays. This would explain why we do not observe high levels of gamma ray emission in the low-energy fields associated with LENRs. We can also consider that the heat generation in LENRs is due to fundamental processes involving electron scattering through interactions with gravitons, which are emitted during the mass-energy conversion of nuclear binding energy.

5. Two Possibilities of the plasmons with Low-Energy Protons

The key reaction process in LENB is electron capture, as it triggers LENR. Plasmons can interact with protons in two ways: by stopping effect or by capturing electrons.

The most likely interaction is the stopping effect. Low-energy protons on the surface of plasmonic graphene can be trapped by an electron flow in one direction, appearing as if ionized protons moving rapidly within electron clouds. As a consequence, the protons assume a lower energy state, exhibiting behavior similar to ionized particles. In weaker plasmons, protons can exchange potential energy with the free electrons temporarily as they pass through the range where the K-orbit electron resides. In more excited plasmons, protons share potential energy with all surrounding free electrons within a wider range equivalent to a single electron potential in total.

The other interaction is electron capture, which occurs when electrons flow in the right direction towards the protons within the range where they can fuse with them. This process leads to LENR, as discussed in the previous section.

6. Concluding Remarks

In just over six months, the author has become deeply interested in the LENR field, despite having recognized its potential over decades while studying hot fusion. Despite the long-held belief that LENR is not viable, significant progress has been made in experimental research in recent years, leading many experts and enthusiasts to question whether this technology could ultimately sustain our lifestyle and provide hope for future generations. Although the author has not yet provided experimental data or additional details on theoretical perspectives, the LENR community has welcomed this incomplete and uninitiated individual. The author hopes that any insights presented in this work can contribute to the further development of LENR as a viable energy source for humanity.

Acknowledgements

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