

# **SOLID STATE FUSION: A POTENTIAL GAME-CHANGER INTRODUCED IN 1989 AND MADE RELIABLE AND REPRODUCIBLE IN 2025.**

## **INTRODUCTION**

The challenge of initiating and sustaining nuclear fusion in a solid-state material has eluded physicists for the past 36 years after they thought they had a solution in hand. While the initial reports of a breakthrough in 1989 appeared compelling, even after decades, scientists who have remained true believers were still having very limited success. It took weeks, months, and even years to get their experiments to produce positive energy results. And most of the time they got nothing.

During the past year, two Southern California scientists, [Douglas](#)

[Pinnow](#) and [Kirk Miller](#), achieved a long hoped for second breakthrough - triggering the solid-state fusion process to achieve immediate startup. This has revived the prospect of clean, sustainable, and inexpensive energy. Underpinning their work was the realization that solid-state fusion was **NOT** limited to cold processes as expected by most others (and frequently called 'Cold Fusion'). Rather, it includes an extremely hot process that takes place deep within the solid-state structure where it is impractical to measure temperature. Calculated temperatures in submicroscopic regions can exceed a million degrees Centigrade while the average temperature of the bulk material remains low.

As Pinnow and Miller describe solid-state fusion, it will provide uninterrupted power to everything from laptops and phones to the

Internet and AI, and communities and nations.

## THE STORY

In 1989, two scientists, Martin Fleischmann and Stanley Pons, both tenured Professors of Chemistry at the University of Utah, claimed they had discovered a new form of fusion that took place at room temperature inside a small, insulated glass jar (called a dewar) in their laboratory. The ramifications of this work, dubbed ‘Cold Fusion’ by the press, were potentially world-changing! If it could be made to work, the less favorable economics of other forms of energy production would render all of them obsolete. But that did not happen.

## THE RAPID DEMISE OF ‘COLD FUSION’

Shortly after this seeming breakthrough in 1989, the University of Utah called a major press conference to announce the discovery of 'Cold Fusion' (a process that takes place at room temperature, not the super-hot temperature that is required to sustain fusion inside the sun). All the major TV news stations, including the respected McNeil-Leher News Hour, were present and the next morning the catchy name 'Cold Fusion' was the cover story in the Wall Street Journal. By the end of the week, it also became the cover story for Time Magazine. **'COLD FUSION' HAD STORMED THE WORLD ALMOST OVER NIGHT!**

MAY 8, 1989

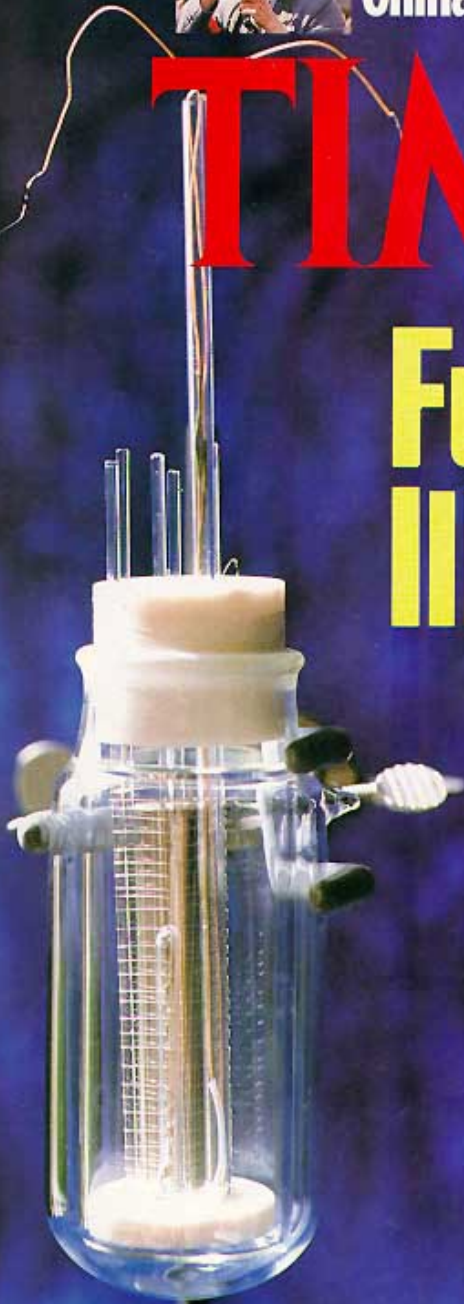


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# TIME

## Fusion or Illusion?



**How two obscure chemists stirred excitement – and outrage – in the scientific world**



In this picture, Fleischmann is pointing to their touted 'Cold Fusion' reactor while Pons is standing in the background. On the left, you can see a close-up of their reactor inside of the glass jar. It contains a vertical rod of palladium metal (about the size of a pencil) in the center of the jar. This rod is immersed in a special type of water – heavy water [Normal water molecules ( $\text{H}_2\text{O}$ ) modified with a heavy isotope of hydrogen called deuterium, D. The chemical formula for heavy water is properly written as  $\text{D}_2\text{O}$ ]. The palladium rod material is known to have an unusual ability to absorb exceptionally large amounts of hydrogen (or deuterium).

When the rod was connected to the negative side of a battery, positive deuterium ions formed in the heavy water were attracted to the negatively charged rod and absorbed. This process is well known. It is called electrolytic charging.

What was completely unexpected was that when the concentration of deuterium in the palladium rod reached a certain high level, **the palladium rod magically began producing heat** that was measured by the thermometer that can be seen sticking out of the top of the dewar. Fleischmann and Pons claimed the total heat produced far exceeded the output of any known chemical reaction - so they concluded that they must be observing a more powerful fusion reaction in their “cold” room temperature jar. No hot gas plasma was required. The total cost of their contraption was several hundred dollars— far from the \$22 billion price tag for the conventional hot plasma fusion reactor (ITER) that is under construction in France. Unfortunately, no one was able to reliably reproduce Fleischmann and Pons’s experiments.

By 2003, the mystery of ‘Cold Fusion’ was growing deeper and more intriguing. Having retired, [Doug Pinnow](#), a PhD physicist, had spare time as well as the interest in trying to solve the puzzle of ‘Cold Fusion’.

Scientists then working in ‘Cold Fusion’ were still having very limited success reproducing Fleischmann and Pons’ original result. It still took weeks, months, and even years to get their experiments to produce any positive results.

### **DOUG’S Aha MOMENT**

Then, Doug recalled an unusual experience he had years ago while working as a young Navy Lieutenant with Admiral Rickover.



**Doug Pinnow & Admiral Rickover “Father of the Atomic Submarine”**  
*(circa 1963)*

He assisted in starting up several new atomic reactors on submarines without using any neutron triggering sources - which are normally employed to start all modern fission reactors. Instead, the operators patiently waited over the course of a half-day, or so, for a cosmic ray

from outer space to hit the reactor and kick-start the fission process. Doug came to realize that the same cosmic ray triggering process used on those submarines should also work to start a fusion reactor. What he didn't understand for several years was “Why did it take so much longer to start up fusion reactors: typically, weeks, months, years, sometimes never?”

Then, one morning in 2015, Doug woke up and found that the answer to this question had come to him overnight. It was a classical Aha moment. He suddenly realized that submarine fission reactors were about a million times larger than typical research fusion reactors. So, the probability for a cosmic ray to hit the smaller target (a fusion reactor) was about a million times less – and the waiting time for start-up would be as much as a million times longer! **That explained everything.** Based on the randomness associated with the arrival of

cosmic rays from outer space, some lucky scientists received early hits to start their reactors, perhaps in several days or weeks. But most of them lost patience after that.

The same day as Doug's Aha moment, he searched for and found a candidate to serve as an alternative to cosmic rays that could quickly trigger fusion reactors into operation. What was needed was a small amount of radioactive material that spontaneously emitted alpha-particles (very fast-moving helium nuclei). He realized that the addition of certain atoms, such as thorium or depleted uranium, to the palladium metal could serve the same triggering function as cosmic rays – but they could be made so plentiful that start-up would be almost instantaneous. He was convinced that his invention would work. **BUT HOW TO CONVINCe OTHERS?**

Doug realized he needed something that Fleischmann and Pons never received, acceptance of their work in a credible peer-reviewed scientific journal. Acceptance requires both hard work and credible scientific results. Unfortunately, Doug was already too old to raise money from investors to underwrite a risky scientific adventure that required a well-equipped laboratory that he no longer had.

Then, almost as in a feel-good movie script, an old Bell Labs friend and co-worker of Doug's, Frank Dabby came back out of the blue into his life. HE OFFERED TO PURCHASE AND SET UP WHATEVER EQUIPMENT DOUG NEEDED. Frank's only request was that if Doug were fortunate enough to win a Nobel Prize for his work, he would split the prize money with him.



Frank (on the right) and Doug closing the deal in 2023

At that point, [Kirk Miller](#), another old friend and a very capable scientist, joined Doug for the final push to prove out his invention for triggering the start-up of a Solid-State Fusion reactor.



Kirk

Eight weeks later, the lab work was completed and their results were subsequently accepted for publication in the peer-reviewed Journal of Condensed Matter Nuclear Science (JCMNS). Here is the title page:

**RANDOM THERMAL SPIKES OBSERVED IN 99% PALLADIUM –**

**1% URANIUM ALLOY FOIL ELECTROLYTICALLY CHARGED WITH  
DEUTERIUM:  
CONFIRMATION OF SOLID-STATE FUSION**

by

Douglas A. Pinnow\* and Kirk Miller\*

**ABSTRACT**

Random thermal spikes have been experimentally observed at ambient temperature in small palladium metal foils electrolytically loaded with deuterium. We believe those spikes can be identified with deuterium fusion events triggered by alpha-particle emission from a small amount of depleted uranium melted into the foils.

The many thermal spikes they observed added up to the production of

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considerable thermal energy – the desired end-product from a fusion reactor.

Their experiments closely followed those of Fleischmann and Pons. Except they added some ‘special sauce’ to the palladium metal electrode in the form of a 1% concentration of depleted uranium - mentioned in the title (and circled in blue).

They calculated that this small amount of depleted uranium would trigger nuclear fusion reactions approximately 200 times per second in the palladium metal foil that they used in their experiments – more than enough to validate Doug’s invention for nearly immediate start-up of a fusion reactor. So, all Doug and Kirk had to do was electrolytically load the palladium metal foil containing a little uranium with deuterium. Otherwise, they followed what Fleischmann and Pons did 36 years ago. And presto, a fusion chain reaction involving billions of deuterium ions was initiated.

THEIR REACTOR HAD GONE CRITICAL!!! In so doing, they confirmed **SOLID-STATE FUSION** (as underlined in red in the above title).

**MORE TOPICS OF ONTEREST:**

### **CONFIRMATION OF SOLID-STATE FUSION**

- A MAJOR SCIENTIFIC BREAKTHROUGH THAT HAS BEEN PEER-REVIEWED AND PUBLISHED.**
- THE SMALLEST CONTROLLED NUCLEAR FUSION REACTOR EVER OPERATED (BASED ON SOLID STATE PHYSICS).**
- CLEAN, INEXPENSIVE, SUSTAINABLE, NUCLEAR ENERGY.**

## WHY IS FUSION ENERGY SO IMPORTANT?

A source of clean, inexpensive, reliable, and sustainable energy for all continues to be a world-wide goal. Not fission energy that produces radioactive waste. Who would want to live next door to the Three Mile Island fission power plant? Nor oil and gas that fill our atmosphere with byproducts that cause global warming. But clean, controllable nuclear fusion energy.

The only byproduct of solid-state fusion is helium gas – the same harmless stuff that is used to inflate children’s balloons.

**Importantly, there will be no greenhouse gases released that are the main cause of global warming!**

**THINK OF THE POSSIBILITIES –**

Because fusion fuel has an energy density about a million times greater than gasoline, one can imagine filling your car once with enough fuel **to last an entire lifetime!**

Even better, imagine a world where no more wars are fought over ownership of oil fields. Energy would be dirt-cheap because fusion fuel can be distilled directly from sea water! And there is enough of that to last for many, many centuries to come.

For a deeper insight into the prospects for fusion energy, please view this 4-minute **VIDEO** that is available under the category NEWS in the Selection Bar.

## **THE PHYSICS OF FUSION**

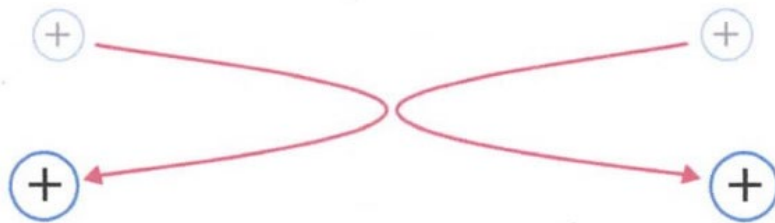
To appreciate this breakthrough requires some basic knowledge of the fusion process. So, here is a quick 1-minute course.

When two heavy hydrogen ions (isotopes called deuterium, D), that are moving very fast slam into one another they stick together (react) to produce one helium ion (He) and a lot of nuclear energy. A very high temperature is required to make the deuterium ions move sufficiently fast for this to happen.



NOTE: The simplified reaction equation shown above includes the correct starting components, deuterium D, and end component, helium He. But the reaction is somewhat more complicated with an intermediate step involving tritium, as discussed in paragraphs [0047] through [0062] in the Patent Application Publication found on this website.

At lower temperatures, the two positive deuterium ions cannot get sufficiently close together to react. Their positive electrical charges repel one another (as pictured below). Such repulsion is well-known and is called ‘electrostatic repulsion’ (AKA ‘Coulomb repulsion’).



**FACT:** To overcome Coulomb repulsion requires a very high temperature comparable to that found inside the sun (around 15 million degrees Centigrade).

So, nuclear fusion has always been understood to be a “hot” process by

most physicists – not “cold”. This remains a very important unresolved issue that is discussed under the heading **PERSPECTIVE**.

**This concludes the physics course – except for the final exam.**

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**Exam Question:**

**Is conventional nuclear fusion a hot or a cold process?**

**Answer: Definitely hot! (Requiring temperatures comparable to those found inside of the sun – around 15 million degrees C.)**

**YET, CONFUSION HAS CONTINUED OVER “HOT” vs “COLD” -**

For several decades the press and some in the scientific community

have been confused over whether fusion is “hot” or “cold”. It is likely that many in the press have come across the term ‘Cold Fusion’. Pinnow and Miller believe this name is a serious misnomer that has hindered progress in the field of Solid-State Fusion.

## **NUCLEAR FUSION TECHNOLOGY HAS MAINLY EVOLVED ALONG TWO DIVERGENT PATHS:**

- **Conventional Hot Gas Plasma Fusion** - which is very expensive and well understood by physicists.
- **Solid-State Fusion** - which is, potentially, very inexpensive but less well understood. Some physicists view it as a maverick technology.

## **A STATUS CHECK ON HOT PLASMA FUSION**

Physicists are confident that hot gas plasma fusion works. They are actively engaged in the construction of a demonstration plasma fusion reactor in France, known as the ITER reactor, with the participation of 33 nations, including the United States. Here is a brief status report on this huge project that began two decades ago:

- (1) Over one million parts.
- (2) Present estimated cost \$22 billion.
- (3) Still under construction - about 75% **complete**
- (4) Over 2,000 employees, including scientists, construction workers, etc.

Below is a view of the plasma reactor's central chamber. When finished, it will contain a gas plasma hotter than the interior of the sun. The plasma will be formed where a picture of the sun has been inserted. When operational, the actual fireball will be so hot that it

must be kept from touching and melting the container's walls by using very large magnets.



For scale, please note the construction workers in the foreground.

Clearly, this reactor won't fit into your pocket, your backyard or even your neighborhood. But Pinnow and Miller have built and

operated a solid-state fusion reactor as small as a postage-stamp (=> **Solid-State Fusion** => The Experiment). And it can be scaled up to any size that is desired.

## SCIENTIFIC EXPLANATION

When one of the depleted uranium atoms deep inside of the palladium foil spontaneously decayed (emitting an energetic alpha-particle) the effect was like a sub-microscopic atomic bomb going off there. Doug had calculated that this event would briefly spike the temperature in the immediate vicinity of the decaying atom to approach the sun's internal temperature - sufficient to fuse two deuterium ions together. The intense heat momentarily created by the first fusion event was sufficient to cause at least one additional pair of neighboring deuterium ions

to fuse, resulting in another temperature spike. And this happened over and over again – billions of times. They had achieved a true fusion chain reaction! - without waiting weeks or months for it to start.

**It wasn't 'Cold Fusion' at all, but very hot fusion** deep inside the metal foil where no one could see or measure the extreme, but very localized, temperature that Pinnow had calculated would occur. Fortunately, Pinnow and Miller could measure the rising temperature of their laboratory fusion reactor – so they knew that it was working.

They have concluded that 'Cold Fusion' was a misnomer for a process better described as 'Solid-State Fusion'. This description is sufficiently broad to include temperatures ranging from

ambient to those inside the sun. Their research has passed the peer review process and has been published in the *Journal of Condensed Matter Nuclear Science* [J. Condensed Matter Nucl. Sci. **40** (2025) 1-15].

**SOLID-STATE FUSION IS NOW A CONFIRMED REALITY!**

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## **MESSAGE TO THE PRESS**

**Please spread the word to your readers and others throughout the world so that everyone may benefit sooner than previously expected from inexpensive, clean, and sustainable fusion energy!**

**P.S. Mankind sits on the threshold of World War III, a fight, to a large extent, over rights to oil reserves. Pinnow and Miller believe that Solid-State Fusion may remove the profit motive behind such a folly.**

**End**