

“Cold Fusion”/LENR/LANR/CMNS⁰ is back in the news... Is it Pathological Science or just barking up the wrong tree?

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Abstract: Cold Fusion might, if claims are to be believed, be looking at the wrong nuclear phenomenon that isn't fusion and sporadic claims of excess energy production might be due to a wholly different process, perhaps the Wigner Energy of the Lattice, unlinked to claims of fusion, thus confusing the issue and holding the field back. We also have reasonable question to the authors regarding their experiment.

“Cold Fusion” is back in the news² after 35 years of intrigue, 100s of millions of dollars funding across several first world nations (and 100s of billions for Hot Fusion) and yet the charge of “Pathological Science”³ still persists! On a personal level, I know some good people in the field and I am not prepared to believe that they are cranks and/or are dishonest, so what might be going on and why can't they demonstrate excess power or reaction products reliably^{4,5,6}?

In a nutshell here is what I believe:-

- The process is not nuclear fusion but driven by x-ray production⁷ and/or an Auger/Electron Capture⁸ process.
- To the first point, if the transmutation of elements is to be believed (and it isn't contamination in the materials or contamination entering the measuring process), both the suggested mechanisms can cause elemental transmutation.
- The linking up of the transmutation to excess power production (or sporadic claims of this) might be a red-herring, throwing-off the researchers on a wild-goose-chase for the wishful thinking that it might be fusion – indeed not all real fusors are over-unity, take the Farnsworth Fusor¹⁴, so this objective may be clouding judgements. (It is telling in the Nature *report*¹ that the correspondents have already made up their minds *what they think it is* and this is not good science reporting on experiments: you have to tie the results to your hypothesis.)

Though, having an open mind doesn't mean we let our brains fallout (Sagan) and there are some questions to the authors of the current paper² in a later section.

Tendering a link between claims of Bubble Fusion and Electrolytic Cell Fusion

Sonoluminescence⁹ is known to produce temperatures in excess of 15,000K and has been implicated in Bubble Fusion¹⁰. On talking to a noted professor yesterday (source confidential, *he is* to be believed, AI/top character/professional standards), he told me that a similar type of experiment had produced neutrons. Intriguing... 15,000K is not a high enough temperature to achieve conventional Hot Fusion, so what might be going on?

We postulate, on the known fact that collapsing bubbles generated by the ultrasound, produce plasma and light and that Bremsstrahlung (German for “braking radiation”) might generate x-rays or indeed even gamma rays (who says that the 15,000K is thermalized, it might have non-thermodynamic equilibrium processes that are even “hotter”?) and these can certainly cause the production of neutrons (via collisions) and nuclear transmutation by this method or an Auger-like electron capture process.

Furthermore, linking the two platforms of Sonoluminescence/Bubble Fusion and Electrolytic Cell Fusion, we believe that the considerable loading of the lattice^{5,6} may give rise to the phenomenon of Wigner Energy^{11,12,13}, which has the ability to cause the lattice to spontaneously (i.e. randomly, sporadically – as by the reports^{5,6}) anneal and “snap back”, releasing considerable heat that may in a similar way to the claims of Bubble Fusion, generate X-rays, Electron Capture processes that lead to nuclear transmutation and reports of neutrons. These may be the “hotspots”⁶ where putative transmutation events are said to occur in the Cold Fusion literature.

In fact a region may form in a lattice that becomes incandescent from the sudden cascade effect of heat released by the Wigner Effect, which is substantial at several kJ per gram^{11,12,13} or 10s to 100s of kJ per mole:- in a spherical

region bounded by R^3 , we play-off heat generation against thermal conduction bounded by a surface area R^2 such that, $\frac{4}{3}\pi R^3 \dot{Q} \gg -4\pi R^2 \cdot \kappa(T) \frac{dT}{dr}$. Where, \dot{Q} is the rate of heat production, $\kappa(T)$ is the thermal conductivity as a function of temperature and $\frac{dT}{dr}$ is the temperature gradient at some thin shell on the boundary. A phase change may drastically alter the thermal conductivity for the worse, isolating the region such that it becomes plasma. This is more likely in a liquid with gas phase change, hence why the effect is perhaps more likely in sonoluminescent in liquids. The Stefan–Boltzmann law would then give the temperature of this region $\sqrt[4]{\frac{4\pi R^2 \dot{Q}}{\sigma}}$ and we might conclude that in a region of the size of a millimetre, a rate of heat generation of 10s of joules in a time of tenths of picoseconds (phonon frequencies in solids are up to 10^{13} Hz), might generate temperatures over 10,000K and lead to the mechanisms suggested for nuclear transmutation by X-rays or electron capture. To test this hypothesis one should look at the spectrum of any emissions, X-rays, electrons, neutrons (etc.) and whether they are continuous.

Questions to the authors of the current report in Nature

1. Regarding the current Nature report, can they give, please, an indication of the absolute amount/mass of transmuted products and can they relate the mass discrepancy to the excess energy production directly?
2. Is the measuring of the excess energy produced promptly or is there a period of "loading" or "energising" the set-up that maybe goes on for many hours before the measurement in their experiment? (Might there be some hidden, unaccounted for store of potential energy in the system?)
3. The paper had some 3 and 4 body reactions in one step in the discussion section looking at potential mechanisms. Isn't that type of thing probably unlikely? In physical chemistry and elsewhere, such reactions are severely rate-limiting.
4. The pipe diameters were quite small compared to the wall material. Do they believe the wall of the pipe material bears any effect in the reactions or does it happen in the body of the liquid contained therein? Would larger pipe diameters or some kind of reaction vessel lay that argument to rest?
5. There were unusual isotope ratios. Has contamination from the pipe alloy material has been ruled out? Has transmuting of the pipe material (by any means: background radiation including induced fission, contamination in the manufacture process) been ruled out to explain the higher atomic number/mass ratios? Was the water thoroughly de-gassed/pure beforehand? The mass-spec was thoroughly purged and calibrated from previous usage?
6. Would they concede that it is possible for the lower mass/lower atomic number isotopes to be generated by non-fission means - electron capture, x-ray or neutron bombardment of the nuclei?
7. Have any reaction, products such as photons and neutrons, had their spectrums checked against known atomic processes/transitions or is some part of the spectrum continuous?
8. Can they always generate their results to order or is the process sporadic? Can they obtain all their data at the instant that the putative processes occur or is the process too fleeting to capture "in the act"? How confident do they feel that if other research groups followed the same procedure that they would obtain comparable results?

Conclusion

It just may be that the whole "Cold Fusion" debacle is not fusion at all but nuclear transmutation is occurring by other means and the attempt to link sporadic claims of excess heat (or even "heat after death") are a red-herring linked to an unrelated effect of lattice relaxation (say the Wigner Effect). The current Nature report would do well to answer sceptics' reasonable questions that we find challenging or imply that they might be breaking Conservation of Energy or well-founded principles in Nuclear Science.

References/Notes

- 0) Low Energy Nuclear Reactions. Lattice Assisted Nuclear Reaction. Condensed Matter Nuclear Science
- 1) The old <http://www.evosci.org> domain has been retired for now, as the service provider (Turbify) upped their fees from free to over £200 a year. Stuff that. I didn't transfer the CNAME and all that in time.
- 2) <https://www.nature.com/articles/s41598-023-50824-8.epdf>
- 3) https://en.wikipedia.org/wiki/Pathological_science
- 4) See National Geographic “Cold fusion remains elusive...” Science News May 29th 2019
- 5) “Briefing on Low-Energy Nuclear Reactions (LENR) Research”, US Dept. Defence, “A scientific survey of the international literature in response to the FY16 NOAA (report on HR4909, 4 May 2016)”
- 6) “Cold Fusion – An Objective Assessment”, Edmund Storms 16/12/2001
- 7) [Ionizing radiation - Wikipedia](#)
- 8) [Electron capture - Wikipedia](#)
- 9) [Sonoluminescence - Wikipedia](#)
- 10) [Bubble fusion - Wikipedia](#)
- 11) [Wigner effect - Wikipedia](#)
- 12) “THE DESCRIPTION OF WIGNER ENERGY AND ITS RELEASE FROM WINDSCALE PILE GRAPHITE FOR APPLICATION TO WASTE PACKAGING AND DISPOSAL”, P.C. MINSHALL, A.J. WICKHAM, BNFL Waste Management Report.
- 13) “Wigner Energy in Irradiated Graphite and Post-Closure Safety”, John Rees, Martin Gilbert, R&D Technical Report P3—80/TR, Environment Agency (UK).
- 14) [Fusor - Wikipedia](#)