Deuterium in 147-atom Pd nanoclusters embedded in zeolite cages

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Abstract

147-atom Palladium clusters embedded in Zeolite cavities enable Cold Fusion
when exposed to Deuterium gas by Klein Paradox Tunnelling of D+D+D+D producing He + He + 47.6 MeV.
Cold Fusion Energy goes to Optical Mode Phonons in the Pd clusters and then to the Zeolite where it is stored as Heatmthat is released by D2O Heavy Water to produce useful energy.
Ejection of He + He and reloading of D+D+D+D is done by Jitterbug transformation between Icosahedral Ground State and Cuboctahedral Metastable State of 147-atom Pd clusters.
Synthesis of 147-atom Pd clusters has been done by Burton, Boyle, and Datye at Sandia / U. New Mexico, USA.
Zeolite synthesis has been discussed by Sharma, Jeong, Han and Cho at Chungnam Nat. Un., Korea.
Based on prior experimental results of Arata and Zhang (replicated by McKubre at SRI) and of Parchamazad the expected energy production is on the order of kilowatts per milligram of Palladium. For details, see
http://vixra.org/abs/1603.0098

Keywords: zeolite, palladium, deuterium, Klein Paradox tunneling, fusion

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1. Why is Palladium uniquely useful for Deuterium Cold Fusion ?

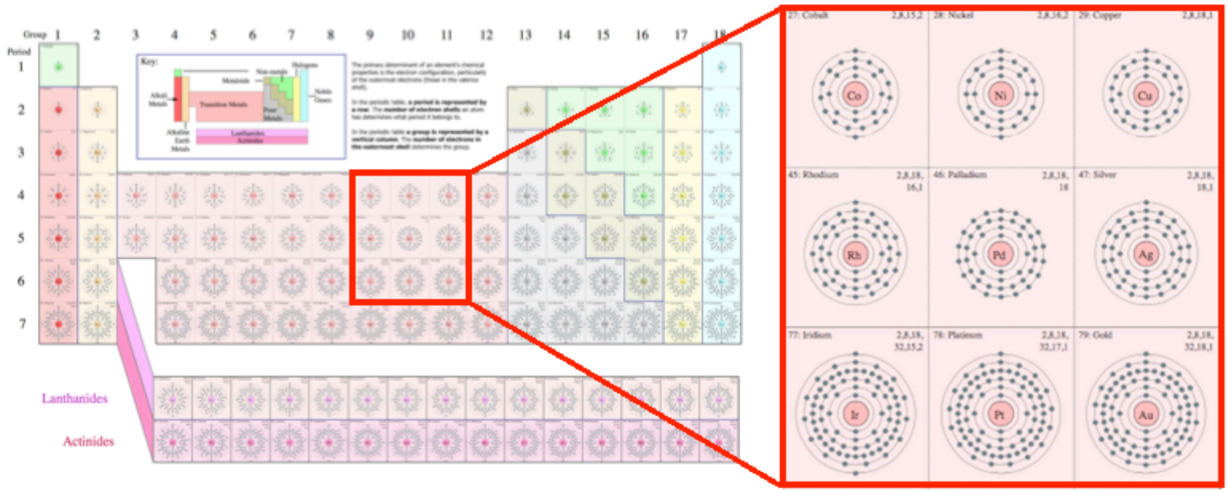


Figure 1. Shell Structrure of Palladium and neighboring elements – adapted from Wikipedia.

Palladium is the only element in its neighborhood whose outer shell has many (not just 1 or 2) electrons.

A full N-shell has s + p + d + f = 2 + 6 + 10 + 14 = 32 electrons. Palladium N-shell has 2 + 6 + 10 = 18 electrons and "holes" to receive 14 electrons. Each Palladium atom has 18-14 = 4 N-shell electrons that can interact with 4 electrons of 4 Deuterium atoms absorbed into a Pd cluster, helping them to participate in a Schwinger coherent quantum state for TSC Fusion. Further, each Palladium atom has 14 N-shell electrons: 12 to fill needs of other Pd atoms and 2 for a Dirac Fermion Band for Klein Paradox Tunnelling.

1.5 nm diameter Pd clusters have 147 atoms and can be in two states: a Cuboctahedral Metastable State and an Icosahedral Ground State that can transform into each other by a Fuller Jitterbug Transformation.

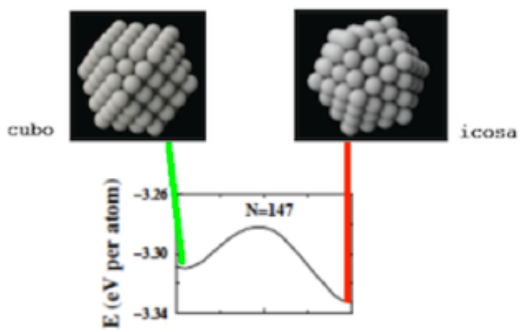


Figure 2. Cuboctahedral metastable and Icosahedral stable states of 147-atom Pd clusters.

The icosahedral 147-atom ground state has 12 exterior icosahedra and a central icosahedron:

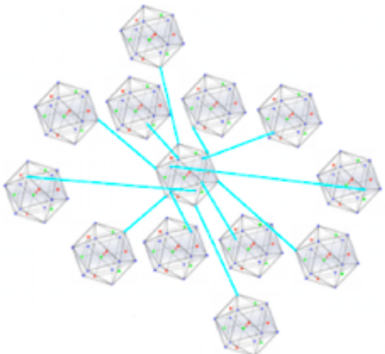


Figure 3. 147-atom Pd cluster as 13 Icosahedra

147 = 1+12+30+12+72+20:   1 atom is at the cluster center and 12 atoms surround the cluster center

5 x 12 / 2 = 30 atoms are in the next layer out   and 12 atoms are at centers of exterior icosahedra

12 x 6 = 72 atoms are outer on exterior icosahedra and 20 atoms are outer between exterior icosahedra

Each 1.5 nm 147-atom Pd cluster fits inside a large cavity of Sodium Zeolite Y

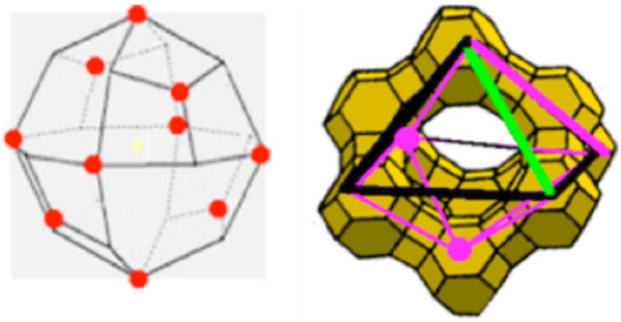


Figure 4. Sodium Zeolite Y cavity structure

2. How does Pd-D Cold Fusion Work ?

Julian Schwinger in 1990 lecture at Universite de Bourgogne said:

“... in the very low energy cold fusion, one deals essentially with a single state,

described by a single wave function, all parts of which are coherent ...”.

Akito Takahashi proposed a process Tetrahedral Symmetric Condensation (TSC) that for 4 Deuterons (D) in an icosahedral cluster of Palladium (Pd) atoms produces a Schwinger coherent quantum state so that Klein Paradox Tunnelling allows the four Deuterium (D) nuclei to fuse, forming two 4He nuclei plus 47.6 MeV energy.

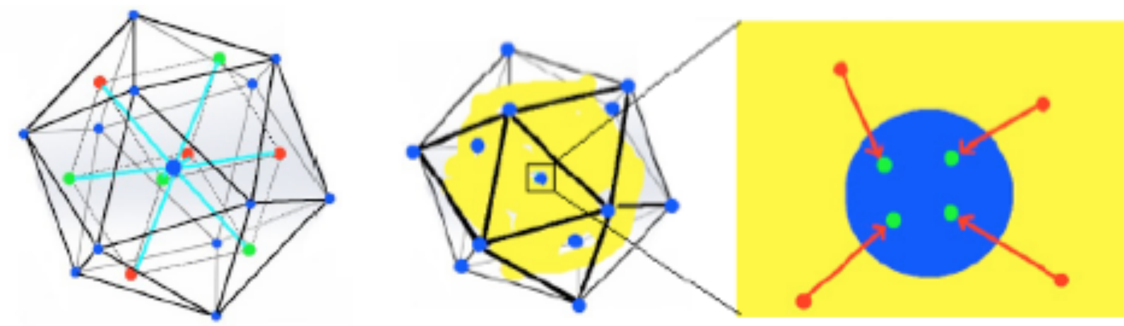


Figure 5. D+D+D+D configuration in Icosahedral Pd forms Schwinger coherent state (yellow) which goes by Klein Paradox Tunnelling to central Pd atom for TSC fusion to 8Be*.

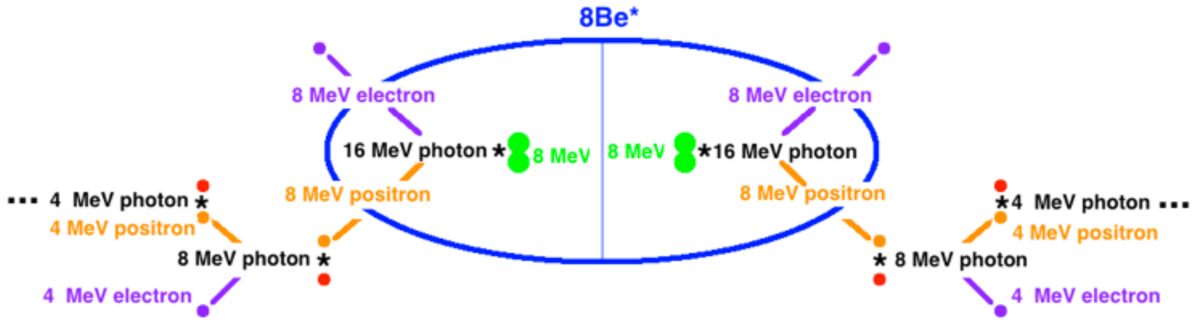


Figure 6. D+D+D+D fusion to 8Be* decays to 4He + 4He + 47.6 MeV

Peter Hagelstein used phonon models for Relativistic Coupling Between Lattice Vibrations and Nuclear Excitation, enabled by break-down of Foldy-Wouthuysen transformation due to 8-15 THz Lattice Vibration Modes, to show direct transfer of the 47.6 MeV energy of Cold Fusion to the Pd lattice as excited optical phonon modes.

The Pd Structure Energy of Excited Optical Phonon Modes is carried by the Zeolite Cage Electrostatic Field (on the order of 3 V/nm) to be stored in the Zeolite as heat.

Some of the TSC Fusion Energy goes to a Jitterbug transformation of the icosahedral Palladium, depleted of Deuterium fusion fuel, to a cuboctahedral configuration which has 6 large square openings through which

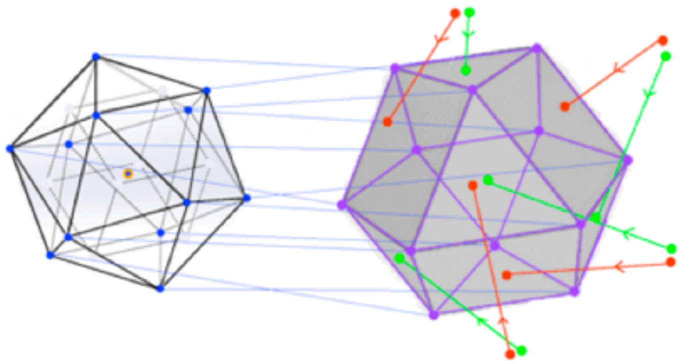


Figure 7. Icosahedron Jitterbug Transformation to Cuboctahedron

The 4He TSC Fusion Product Ash can leave the Pd cluster
and ambient Deuterium Fuel can enter to reload the Palladium cluster.

The reloaded 4 Deuterium nuclei (red dots) and 4 electrons (green dots) form a Tetrahedral Symmetric Coherent Quantum State centered on the 8 triangular faces of the cuboctahedral configuration. Since the icosahedral configuration is the Palladium cluster ground state, another Jitterbug transformation takes the Palladium cluster to an icosahedral configuration ready for another round of TSC fusion.

3. How much energy does TSC Cold Fusion produce ?

A 3-shell 147-atom icosahedral Palladium atomic nanocluster contains 13 Icosahedra
and each TSC Fusion event produces 47.6 MeV

47.6 MeV x 13 Icosahedra / 147-atom Pd Cluster x 4.45 x 10^(-17) Watt-Hours / MeV =
= 2.754 x 10^(-14) Watt-Hours / 147-atom Pd Cluster for each Jitterbug Cycle

Mass of 147-atom Pd Cluster 147 x 106 x 1.66 x 10^(-21) = 2.587 x 10^(-17) milligrams
so at maximum efficiency a milligram of 147-atom Pd Clusters gives 1 KiloWatt-Hour each Cycle.

4. How can the energy stored in Zeolite as heat be used ?

According to a 7 June 2012 techthefuture.com web article by Tessel Renzenbrink:

"... Zeolite is a mineral that can store up to four times more heat than water ...
zeolite retains a hundred percent of the heat for an unlimited amount of time ...
When water comes into contact with zeolite it is bound to its surface by means of a chemical reaction which generates heat. Reversely, when heat is applied the water is removed from the surface, generating large amounts of steam.
The transference of heat to the material does not cause its temperature to rise. Instead, the energy is stored as a potential to adsorb water. The ...[German Fraunhofer Institute]... scientists used these particular properties to turn zeolite into a thermal storage system. They created a storage device and filled it with zeolite pellets.
To charge the pellets, they exposed them to heat.
To retrieve the energy they simply added water. ...".

Here is my design for a TSC-Jitterbug Zeolite Pd-D fusion heat engine:

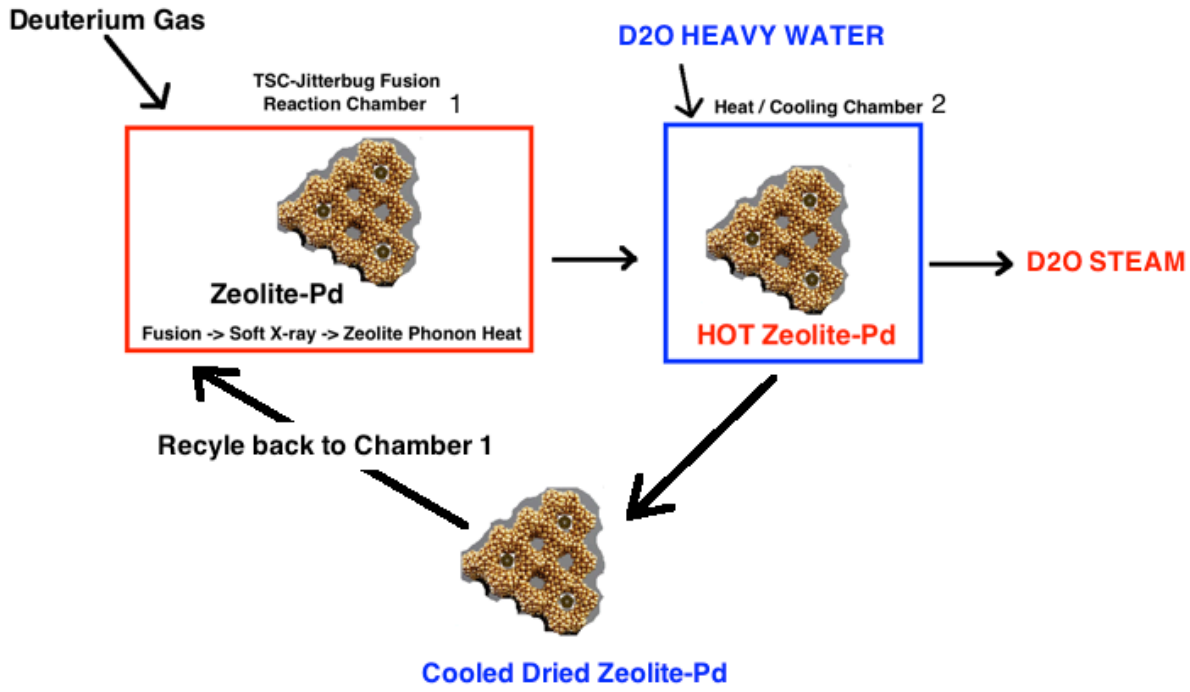


Figure 8. TSC-Jitterbug Zeolite Pd-D Fusion Heat Engine.

(Zeolite-Pd images adapted from

Calvo amd Carre in Nanotechnology 17 (2006) 1292-1299 and from

http://gwenbeads.blogspot.com/2014/04/infinite-skew-polyhedron-faujasite-4446.html)

D2O Heavy Water is used to take heat from the Zeolite to make steam so that Hydrogen from H2O does not poison the TSC-Jitterbug process by replacing Deuterium in the Palladium nanoclusters, a possible problem pointed out by Melvin Miles.

5. Experiment

Experiment of Cold Fusion of Deuterium gas + Palladium Clusters in Zeolite Cavities is now under way by Russ Gries and Arindom Saha in a laboratory of Klee Irwin in California

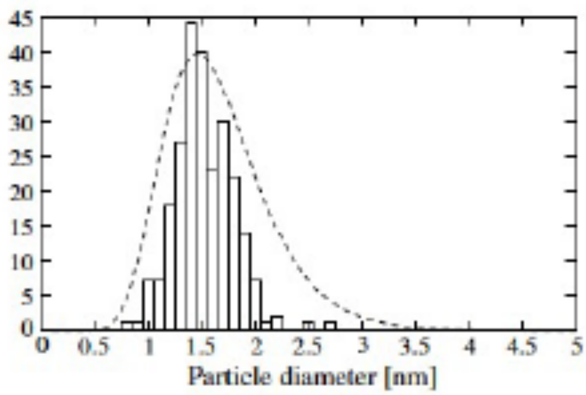
Appendix A: Synthesis of 147-atom Pd Clusters and Embedding into Zeolite

147-atom Pd clusters have diameter about 1.5 nanometers. 1.5 nm Pd Clusters have been produced at Sandia National Laboratories and University of New Mexico Center for Micro-Engineered Materials according to a Journal of Catalysis article

"Facile, surfactant-free synthesis of Pd nanoparticles for heterogeneous catalysts"

by Patrick D. Burton, Timothy J. Boyle, and Abhaya K. Datye showing

"...



...".

Figure 9. Diameter of Synthesized Pd clusters.

Tim Boyle said in email October 2014:

"... We easily remade the Pd NP just need to get TEM to see what size they are.

If they come out good, we can go ahead and make some for you.

Couple of things.

This is very easy and ya'll may want to do it yourselves

(esp after the next couple of comments).

Simply dissolve Pd-acetate in MeOH and stir for 5 min,

let grow for 20 more and should have your size.

The problem is these will continue to grow and plate out onto the sides of the container,
unless you use a substrate.
Would you want these on a substrate, then that'll need to be supplied.
If we make it, we'd have to send it as a solution ...
could you handle this and could you use it?
It won't be a powder, which I think is what you want.
We can dry it down to a powder but not sure what size that will be
or how they'd cluster and how they'd redisperse or in what solvent.
we can try to deposit the materials on a number of surfaces and just let it dry.
Again, not sure how the clustering of these particles will occur.
A gram will take about 2.5 g of Pd(Oac)2 which we have but will need replaced. ...".

Sandia Pd Cluster Recipe

1 - 15 ml of methanol (MeOH) in a scintillation vial

2 - Add 5 mg palladium acetate (Pd(OAc)2) whose color is red-orange

3 - Reduce the Pd(OAc)2 by MeOH to Pd atoms by stirring for 5 minutes with unobstructed exposure to room lighting.

4 - Add 10 mg of substrate in colloidal suspension

5 - Place on elevated stir plate and allow to react undisturbed for 20 minutes.
During 20 minutes the Pd atoms form clusters that grow to size 1.5 nm (147 atoms)
Initially the Pd atom clusters are very small (only a few atoms) and will migrate onto the substrate and continue to grow to size 1.5 nm (147 atoms) at 20 minutes. Color of colloidal suspension changes from pale yellow to dark green over the 20 min

6 - At 20 minutes Pd-loaded substrate (and any remnant Pd still in colloidal suspension) are removed and the Pd-loaded substrate dried

7 - Pd-loaded substrate is placed in reaction chamber where it is exposed to Deuterium gas from tank and calorimeter measurements are taken to measure any heat that might be produced by TSC-Jitterbug fusion (analagous to heat produced by Arata and Zhang (replicated by McKubre at SRI) with no external power input - only palladium powder + deuterium gas) The substrate may be 30-40 nm Zeolite Crystals, such as Sodium Zeolite Y or ITQ-37. At 30-40 nm size each will have about 12 to 16 large Cavities per edge
About half of the Cavities will be on the Exterior Surface of the Tetrahedral Crystal
where they will be easily accessible by Pd atom clusters in the colloidal suspension.

Appendix B: Poster as shown at ICCF20