Exotic Neutral Particle (ENP) Models

Modeli delle
Particelle Neutrali Esotiche

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Background

The difficult relationship between theory and experiment

- After 30 years few (if any) models attempting to explain CMNS have achieved acceptance outside its proponents.
- Few experiments set out to test models.
- Many models fail to illustrate what phenomena they explain nor what they predict.
- Obsession with demonstrating F&P were right (verifying only excess heat) but overlooking the science and nuclear measurements.

What nuclear reactions are we familiar with in condensed matter?

- Nuclear decay (but not usually possible to enhance rates to useful levels).

- Nuclear fission of actinides stimulated by neutrons. (producing intense beta-radioactive products). Rates can be controlled by neutron moderators and absorbers.

Back to basics...

- What kinds of nuclear reactions are fast?
- What kind of reactions produce no radiation?
- (What kinds of reactions produce heat?)

Fast Reactions if ...

- No energy (Coulomb) barriers for either products or reactants.
- No electro-magnetic transitions (no prompt gammas)
- No weak interactions.
- No multi-body fusion.
- Compatible with Conservation Laws.

Examples of fast reactions

			barns
• n+He^3	->H^3 + p	+0.764 MeV	55000
• n+Li^6	->He^4 + H^3	+4.783 MeV	940
• n+ B^{10}	->He^4 + Li^7	+2.790 MeV	3890
• n+Xe^{135}	->Xe^{136*}	+8.084 MeV	2.10^6

Fragmentation or long lived excited states enhance rates.

No prompt gamma radiation if..

- Linear momentum is conserved (2 or more products).
- Spin is conserved
- Products happen not to be beta radioactive gamma emitters

- Nuclear energy must be converted into heat by kinetic energy of products.

How can we avoid radioactive products?

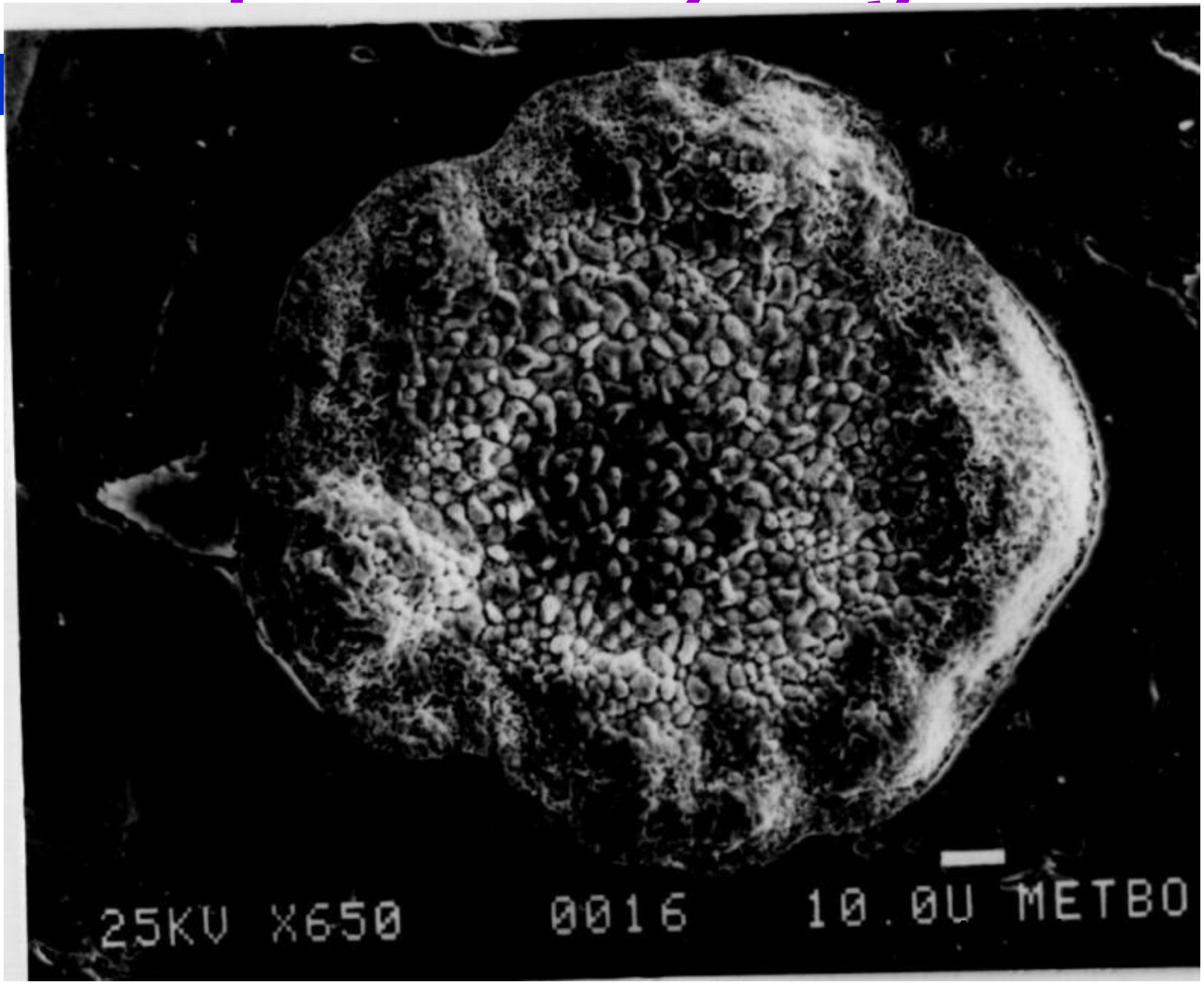
We start with natural (stable) isotopes so if reaction energies are intrinsically low (not the case for nucleon captures) then there is a better chance that the products will be stable also.

Most, (but not all) beta radioactive products produce gammas which would be lethal at a few Watts.

How do we get heat?

- If we invoke weak interactions then energy may be carried off by a neutrino.
- Instead we must propose heavier particles which interact with condensed matter (and release heat there)
- Jacques Ruer analysed the possibility that ENPs could cause hot spots. (Toulouse 2015)

Frozen Hotspot on heat producing Nickel exposed to hydrogen.



Conclusions from Hotspots

The existence of visible molten hotspots implies at least 10,000 nuclear reactions have occurred in the same place in rapid in a short time interval.

As molten metal destroys chemical structures, this rules out Nuclear Active sites, Coherence as possible mechanisms!

Can we avoid radiation with coherence?

Giuliano Preparata showed that coherence alone could not explain CMNS unless ~80 eV potential wells also existed.

If such wells exist, there would be a very exothermic chemical reaction between helium and the host metal. Not observed!

Conclusions so far...

- >1 reactants (otherwise it's decay)
- 2 reactants (to avoid multi-body reaction)
- >1 products (to avoid prompt gammas)
- neutral reactant (to avoid Coulomb barrier)
- neutral product (to avoid Coulomb barrier)
- Modest exothermic reaction (to avoid beta radioactivity)

Compatible Models

- **Erzion Model (Bazhutov)**
- **Polyneutron Model (Fisher)**
- **Neutron hopping (Hagelstein)**

Minimal ENP Model

- Assume 2 species of neutron transfer carriers: **Э^o & Э$_N$**
- They react exothermically and catalytically with limited natural isotopes
- **^{x}R + Э^o → + ^{x-1}R + Э$_N$**
- **^{x}Q + Э$_N$ → + ^{x+1}Q + Э^o**
- Only 1 neutron is transferred at a time.
- Only tiny catalytic numbers of ENPs are required!

Why minimal?

- I have omitted Bazhutov's **Э$^-$** because if it existed it would catalyse muonic like fusion which is not observed.

- I have omitted multiple neutron transfers as in Fisher's polyneutron theory because it predicts unobserved runaway in deuterium.

How do we get heat & ^{4}He?

- Because ENPs are neutral, they have a high cross section for elastic scattering thus causing local heating
- So mean free path is very short.
- Local hot spots
- Chain reaction required for measurable heat and products.

ENSAP Software

- Analysis carried out by ENSAP – Exhaustive Nuclear Software Analysis Program.
- Assumption: Spin is conserved.
- Collis W; “ENSAP Software Tool To Analyse Nuclear Reactions” Proc ICCF7.

ENP Model requires a heterogeneous system…

1. Donors (isotopes which bind their last neutron weakly)-
2. Acceptors (isotopes which can bind an extra neutron strongly).
3. A souce of ENPs! (Not understood at present)

ENP reactions
Lithium

- Li^6 (7.59%)+ $Э^o$ → $Э_N$+Li^5 +2.273 MeV
- Li^5 → p+He^4+1.965 MeV

(Piantelli's Cloud Chamber results explained).

- **Heat, He4, protons, no radiation!**

ENP reactions
Carbon

- C^{13} (1.11%)+ $Э^{o}$->$Э_{N}$+ C^{12} +2.990 MeV
- C^{13} (1.11%)+ $Э_{N}$->$Э^{o}$+ **C^{14}** +0.240 MeV

- Although **C^{14}** is beta radioactive there are no gammas.

- **Heat, no gamma radiation, chain reaction!**

What about deuterium?

- $H^2 + Э^o \rightarrow Э_N + H^1 + 5.712$ MeV

- An arbitrary parameter in all these examples is the neutron separation energy of the ENP. This can be determined by minimizing predicted gamma radioactivity.

Fuels

- Donors: H^2 , Li^6 ,C^{13}, W^{183}, Pt^{195} & 25 others
- Acceptors: C^{13}, Cl^{35}, Si^{28}, Si^{29}, Rb^{85}, & 17 others

Why haven't we already detected ENPs? (Mastromatteo 2006)

Neutrons are typically detected by ^{3}He or BF_3.

ENPs don't react with boron.

But are detected by:-

$^3He + Э^o \rightarrow Э_N + 2H^1 + 0.218\ MeV$

$^3He + Э_N \rightarrow Э^o + {}^4He + 12.641\ MeV$

Conclusions

- Chain reactions producing heat, helium, without penetrating radiations are predicted.
- Elements which are predicted to sustain chain reactions have all been present with anomalous heat. Li, C, W, Pt.
- Isotopic anomalies are predicted.