Metal Hydrogen Energy with Nanopowder

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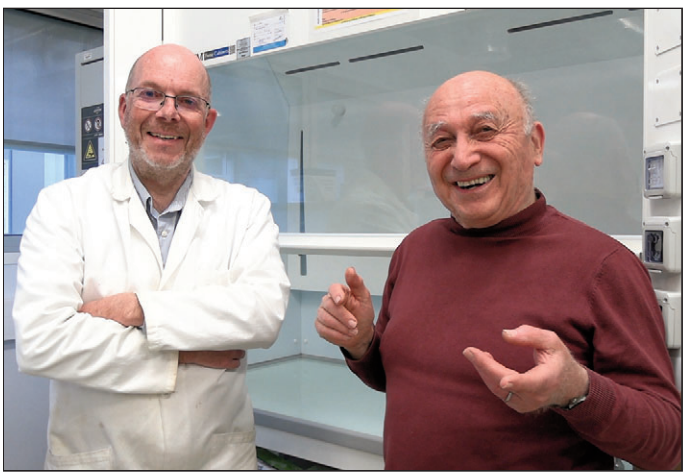
Hydrotalcite nickel nanopowder

An inexpensive process for creating nickel metal nanopowder suitable for solid state fusion generators is being developed in France. Designed to host hydrogen for fusion reactions, the nanomaterial signals a new phase of research, with more nuclear active and affordable nanomaterial readily available.

Nanoparticles are known to generate excess heat when exposed to hydrogen. In the 1990s, Yoshiaki Arata and his team produced 10 Watts excess heat power over 12 weeks from 3 grams of palladium-black nanoparticles infused with heavy-hydrogen deuterium D_2, translating to a total 73 MJ of energy. Akito Takahashi generated thermal power of 226 Watts over several weeks from 505 grams of copper-nickel nanoparticles in a zirconium matrix using regular light-hydrogen H_2 to make a total 683 MJ of energy. These, and other successful nanoparticle results, are listed in the presentation "Condensed Matter Nuclear Reactions in Nanomaterials"[1] by Lawrence P. Forsley, a research scientist working with NASA.

Currently, a team at Tohoku University, in collaboration with Clean Planet, Inc., is engineering a commercial heating unit based on a reactor core made of wafers of alternating nano-layers of nickel and copper to be loaded and de-loaded with light-hydrogen.

All of these nanomaterials have success in thermal power yield, but are expensive or complex to create. Christophe Le Roux, a chemist at the geological lab in the Centre National de la Recherche Scientifique (CNRS) in Toulouse, found a way to make nickel-copper nanoparticle powder for use in LENR reactors using a simple method with hydrotalcites. Le Roux is working with Jean-Paul Biberian, Robert Michel, Mathieu Valat and Jacques Ruer to produce, treat, test and analyze the nanopowder for its heat-producing capability. In the last four years, through COVID and supply chain issues, the team has suddenly found themselves at the leading edge of nano-structured technology and design.



CNRS chemist Christophe Le Roux and physicist Jean-Paul Biberian.

Hydrotalcites nanopowder for hydrogen-metal reactions

Hydrotalcites are found in nature, composed of chemical elements found in the earth's crust—such as magnesium, aluminum, oxygen, hydrogen and carbon. These elements are found in rivers, streams and groundwater, for instance, and will precipitate at locales where the waterways meet. "It is the beauty of the synthesis of hydrotalcites. Nature makes all the stuff," says Le Roux of the clean fuel preparation.

Hydrotalcites form as salts and oxides precipitate chemically into tiny nano-layered crystal arrays when mixed within a base solution of water. For LENR reactions in the lab, a few metal catalysts known to host solid state fusion reactions are added to the starting powder mix to create active nanomaterial to host fusion.

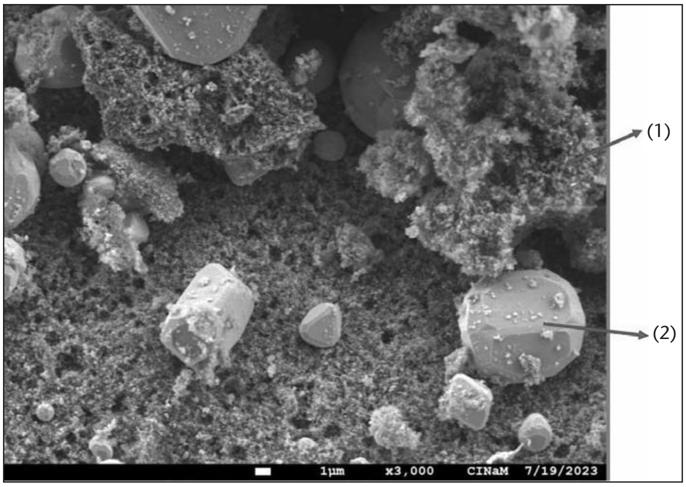
Le Roux makes the material in his lab at CNRS and wrote about the process in a report titled "Description of Hydrotalcite Synthesis":[2]

> …nickel, copper and aluminum hydrated salts ($NiCl_2$, $CuCl_2$ and $AlCl_3$) are dissolved in water and form solution A. Solution B is prepared by dissolving in water the other components of the synthesis like sodium hydroxide and sodium carbonate. Then, under stirring, solution A is poured dropwise on solution B and the green suspension obtained is eventually heated at 65°C overnight. Finally, the solid obtained is washed, oven dried and milled as a green powder.

Jacques Ruer, President of the French Society of Condensed Matter Nuclear Science, illustrates the product further: "This is inter-layered at the molecular level. A monolayer of alumina oxide, a layer of water, a layer of nickel-oxide, a new layer of water, a new layer of alumina-oxide, and so forth."

"You just have to mix chlorides or nitrates of the elements you want to build the hydrotalcite," Le Roux says of the quick process. "For example, in this case, it's nickel, copper and aluminum, in the right proportions. Then, you just have to mix this with a base, which contains the carbonate and sodium hydroxide. A first-year student could mix hydrotalcites."

By just mixing the metal powder with the salted water, the hydrotalcite nanoparticles form. Le Roux shakes the mixture vigorously to blend the particles well, to further the mix. Allowing the solution to sit for a while provides a more "crystallized" hydrotalcite structure. There is almost a 100%



(1) Nanostructured powder. (2) Unexpected crystals.

yield into the nickel nanoparticles.

The water must be removed to make a dry powder and the separated water contains only 40 parts-per-billion of nickel.

"So that means, in this process, all the nickel, all the copper, all the elements, have been precipitated on hydrotalcite. You can almost even drink the water after the synthesis because it contains almost no nickel in the process," claims Le Roux.

The dry powder appears green from the nickel, and must first be treated to generate maximal heat. Treatment of the powder consists of pumping hydrogen in and out of the material. At some point, the initially green powder becomes black and magnetic.

Le Roux says, "The mineral becomes magnetic because the nickel, which is nickel cation in this powder, is reduced as nickel metal nanoparticles in the hydrotalcite process."

The nanoparticles of nickel and copper emerge from the process chaotic, with unexpected nickel crystals populating the cauliflower-like nanomaterial. Designing the material to maximize the nuclear active environment is crucial to making big heat. Mathieu Valat, who splits his time between the Laboratory for Experimental Nuclear Physics (eLBRUS) at University of Szczecin and his home in the South of France, works to process the powder so it's ready for a reactor.

"I'm able to basically tailor what is produced in a very chaotic precipitate environment, into something that is extremely conformal," Valat says of his work on the powder. "We can design the amount of amorphous structure to the amount of metallic active sites, and by being able to design the powder the way we want, we can design the nuclear active environment that will suit the reaction to occur. I'm designing a nuclear active environment at the nanoscale."

Valat explains, "Now with the platform that we have, which is the hydrotalcites, we have a non-sintering powder, so we have properties that allow us to go to higher temperature, hence to sustain a reaction into a configuration that will be producing a lot of useful energy."

Excess heat at high temperature

The idea to make nickel metal nanoparticles came during a chance reading of a chemistry paper.

Le Roux recalls, "I remember very clearly one paper, it was a review paper. And I saw a picture showing that hydrotalcites could lead to nickel nanoparticles on alumina. And when I saw this picture, I said, 'We have to try that.' And I did it. It worked perfectly well. So it's a very easy synthesis. And this is the one that I sent to Jean-Paul."

Jean-Paul Biberian is a physicist and veteran researcher with a specialism in calorimetry. He has performed more replications of cold fusion cells than anyone on the planet.

"So he gave me this powder," says Biberian, "and I didn't know if it would work or not, but as he said, this powder produces nanoparticles of nickel, and we know that nanoparticles are effective. So, I put it in my calorimeter, and at low temperature nothing was happening. I went to higher temperatures, and above 700°C or maybe 800°C, something happened, and there was excess heat, only above certain temperatures."

Heat flow calorimeter 1A operates in Biberian's private lab and is able to go up to 1000°C measuring with a precision of 100-200 milliWatts. Using about 20 grams of powder, he has measured more than 10 Watts of excess heat. Biberian has reproduced the effect many times in his lab, and has a drawer full of samples he's tested.

"I can put in 70 Watts and measure 80 Watts out, so about 10 Watts of excess heat, so the COP is not that good," Biberian says.

Biberian reported on some of the nanopowder data in 2022 at ICCF24[3] and again in 2023 at ICCF25.[4]

Scale up at VEGATEC

Engineer Robert Michel is founder of VEGATEC, a company that focuses on industrial pipes and associated control systems. He sold the company, but still maintains an office and lab space. Biberian has partnered with Michel to reproduce and increase excess heat measured from the nanopowder with an upgraded configuration. Two calorimeters are now operational in a clean room environment.

A smaller cell sits in a yellow box filled with water and is essentially the same design as Biberian's reactor, with some improvements. There is a tighter vacuum system, two pipes for hydrogen gases to load and deload, and a high-quality commercial heater for the interior cell. A second reactor was designed to increase the amount of core material and, hence, excess heat.

"We suppose that the effect is proportional to the mass,


Mathieu Valat looks through a drawer full of Jean-Paul Biberian's nanoparticle samples.


Robert Michel, founder of VEGATEC.

the quantity of powder," says Michel. "So, in order to see more excess heat, we have to use more nanopowder. We can put in the first calorimeter 150 grams and in the second, bigger calorimeter, we can put 800 grams. We measure the power in, the power out, the thermocouple inside the powder, then also, outside the vacuum chamber, we have the isolation system with 218 thermocouples."

It took a long time to get those two VEGATEC systems running. Finding a quality commercial heating unit took an entire year due to supply chain issues after COVID. So far, the first tests of the system have not produced the greater scale of heat they were looking for.

"The only challenge we have is to amplify," says Biberian. "I can get a few watts, up to 10 watts in the last experiments, but if you want to have 1 kilowatt, then you have larger quantities of material."

"The scale up? Maybe the scale up is not so easy," says Michel. "We have to understand what are the mechanisms inside the nanopowder."

"But you know how to cook," continues Biberian. "You can cook rice for one person, but when you want to cook rice for 1000 people, it's more difficult. It's the same technique here, but you have to change the size of your equipment."

He adds, "You see, the powder has to be prepared. So you need some preparation inside the reactor and this preparation is more complicated when you have more mass. And that is a challenge because if you go from 10 or 20 grams to 800 grams, it's a big step. Maybe the step is too big. I don't know. But we're taking our chances."

"Because we are loading the nanopowder with hydrogen," explains Michel, "we don't know exactly if the hydrogen is diffusing properly in this big amount of powder."

In simple terms, "It's just like watering plants," says Biberian. "If you have only one plant, it's easy to water. But if you have many plants? How do you make sure the water goes everywhere to all the plants? You know, if it doesn't go everywhere, the plants will die."

Biberian explains, "So that means we do experiments, try to make it work. And then we have to analyze the powder to see if the powder is in good condition. It's a learning curve, and it takes time to learn. Afterwards, once we find the solution, it will be simple, but first you have to find out how to do it."

Multi-level research needs fulfilled by collaborative effort

Excess thermal power generated from the hydrotalcite nanopowder has been reported from at least three different types of calorimeters. Replications of excess heat using the nickel-copper nanopowder are underway in Italy, Belgium and Sweden. So far, a lab in Italy, using a different type of calorimeter, one without a vacuum, but using the same powder, is getting comparable excess heat measurements.

Valat reveals, "I think one of the most significant replications is happening now in Italy, where you have this simple hot tube, heated by an industrially-designed heater. It's very inexpensive. It's very simple to run. And it seems to be showing great results."

This work on hydrotalcite nanopowder is part of the CleanHME project, funded by the Horizon2020 Program of the European Union Commission, which funds innovative research. CleanHME is a consortium of 16 different laboratories and companies dedicated to researching hydrogen-metal energy. Konrad Czerski, physics professor at University of Szczecin, is the CleanHME Project Coordinator. He and his team have their own successes in advancing understanding of the electron screening effect using the accelerator at eLBRUS, but they are also utilizing the hydrotalcite nanopowder.

The group's original proposal was a prototype reactor with useful energy. While that is unlikely to occur, the ability to generate excess heat from hydrotalcite nanopowder has been demonstrated, and the process of making nickel metal nanoparticles cleanly and cheaply is a next-level evolution for solid state fusion research. Every stage of research has been accessed as needed to produce, test and analyze this product. With this collaboration, Europe finds itself a leader in hydrogen-metal energy research with a nanopowder product that has the power to accelerate reactor core engineering towards a usable technology.

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About the Author
Ruby Carat is an artist, author and advocate for new energy. She is the author of *Discover Cold Fusion*, a comic book about the early days of research, and is currently working on a documentary movie "Metal Hydrogen Energy with Nanopowder."

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