

Thermitic Pyrotechnics in the WTC Made Simple

Three Points of Active Thermitic Material Discovered in Dust from the 9/11 World Trade Center Catastrophe that Anyone Can Understand

by

Jim Hoffman

Version 1.0, April 26, 2009

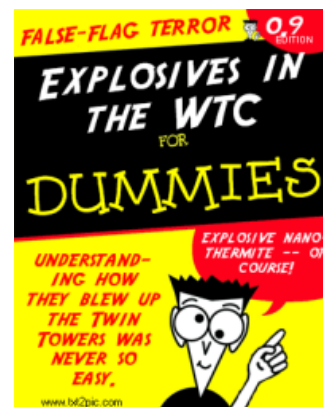
Introduction

The scientific paper [Active Thermitic Material Discovered in Dust from the 9/11 World Trade Center Catastrophe](#) provides, quite simply, proof that explosives were used in the destruction of the Twin Towers. Specifically, the paper positively identifies an advanced engineered pyrotechnic material in each of several samples of dust from the destroyed skyscrapers, in the form of tiny chips having red and gray sides and sharing a very specific three-dimensional structure, chemical composition, and ignition behavior.

The basis and validity of this identification can be grasped quickly by anyone with a working knowledge of physics and chemistry. They need only read the paper's [one-page conclusion](#), and perhaps its section describing the [provenance of the dust samples](#).

But what of the reader whose strong suit isn't the hard sciences? Does one have to be an expert to understand the findings and evaluate the many claims thrown up by "debunkers" to dismiss those findings?

Fortunately, the answer is no. The central observations of the paper can be understood by any intelligent person with some effort. In this thumbnail summary of the paper's findings, I focus on three easy-to-remember features of the red-gray chips established by the paper -- features that undeniably show that the chips are a high-tech engineered [pyrotechnic material](#). Because my description includes some technical language, I have provided a glossary for the benefit of the non-technical reader.



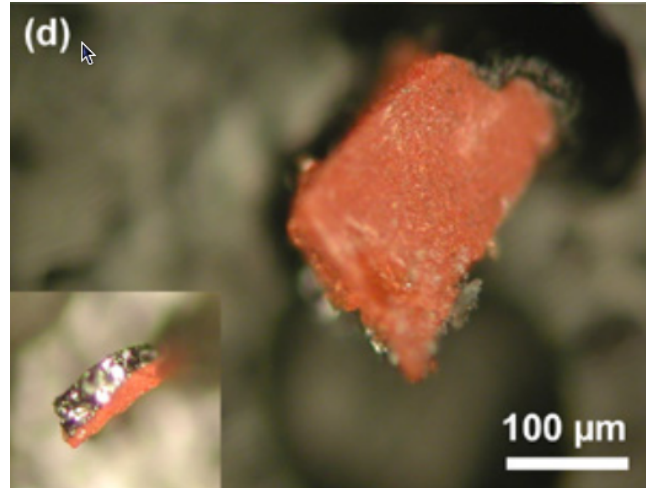
FOR DUMMIES® is a registered trademark of Wiley Publishing, Inc.,

Contents

- [Introduction](#)
- [Three Features of the Red-Gray Chips](#)
 - [1. Physical Structure](#)
 - [2. Chemical Composition](#)
 - [3. Thermal Behavior](#)
- [Conclusion](#)
- [Glossary](#)

Three Features of the Red-Gray Chips

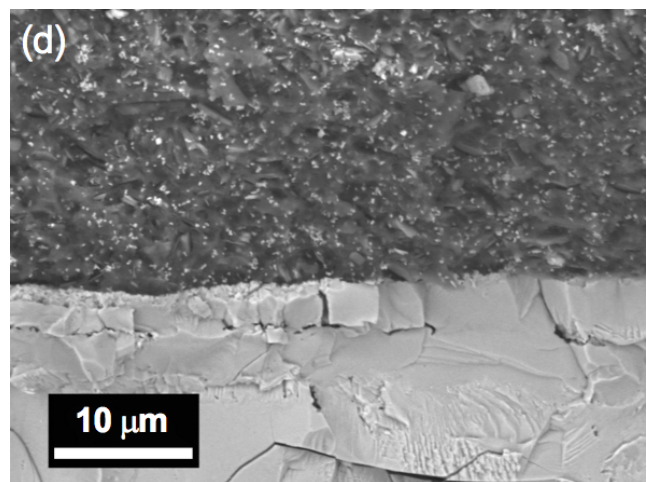
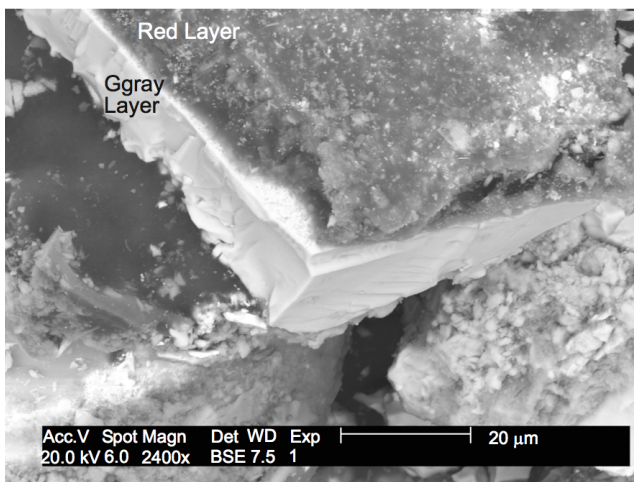
The three features of the red-gray chips highlighted here -- physical structure, chemical composition, and thermal behavior -- clearly establish that they are [aluminothermic nano-composite pyrotechnics](#): advanced manufactured materials that may only have been invented as recently as the mid-1990s. Any one of these three features taken alone shows that the chips contain an energetic material of some sort having no legitimate place in an office building. Any two of these features establishes that the material is an advanced pyrotechnic. That, combined with the material's abundance -- constituting perhaps 0.05 percent of the mass of the dust and therefore likely tens of tons within the buildings -- is clearly incompatible with prosaic sources, and fully consistent with the observations that the Towers were subjected to controlled demolitions.



A portion of Fig. 2, showing one of the red-gray chips. μm means millionths of a meter. The length of the 100- μm bar is therefore 1/10 of a millimeter -- about the width of a human hair.

1. Physical Structure

- The chips, whose structure is consistent from one sample to the next, are clearly an un-natural, manufactured material.
- The red layer is a [nano-engineered](#) composite, containing two types of [nano-particles](#), each highly consistent in size and shape.



Portions of Fig. 4 and Fig. 5: Two scanning electron microscope images of bi-layered chips.

The physical structure of the chips is revealed by microscopic visual inspection, most clearly using a [scanning electron microscope](#). A thin red layer is supported by a gray layer of homogenous material. Zooming in on the red layer shows it to be composed of two different types of particles embedded in a porous matrix: thin plates typically hexagonal in shape, and faceted grains.

Three facts about the red layer are:

- The particles are very small: the plates being only about 40 [nanometers](#) thick, and the grains are only about 100 [nanometers](#) in diameter.
- The particles are highly uniform in size and shape.
- The particles are intimately mixed in a highly consistent composition throughout the material.

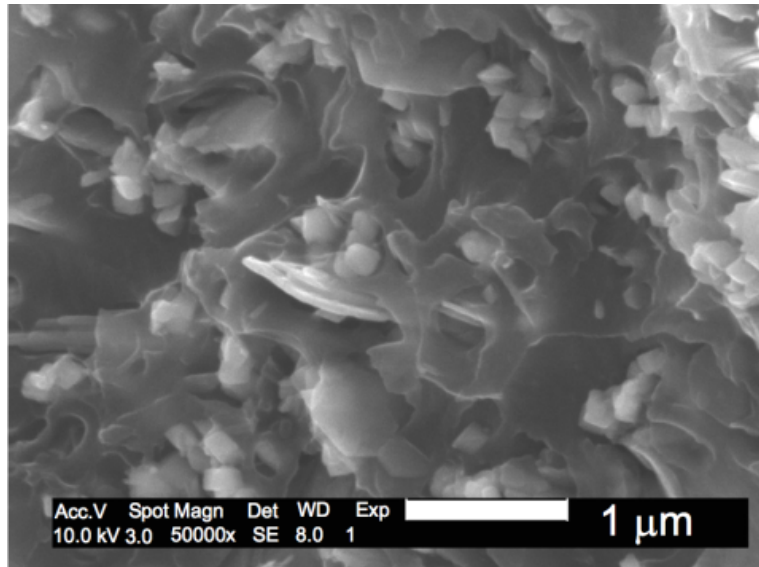


Fig. 9, showing a highly magnified view of the red layer. Note the often-hexagonal plate-like particles, and the smaller faceted particles, both lighter in color than the porous matrix.

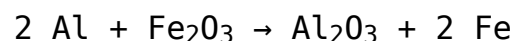
These are all features of a [nano-engineered](#) material. It is not possible that such a material was formed as a by-product of the destruction of the Twin Towers.

>> [FURTHER READING: physical structure of the chips](#)

2. Chemical Composition

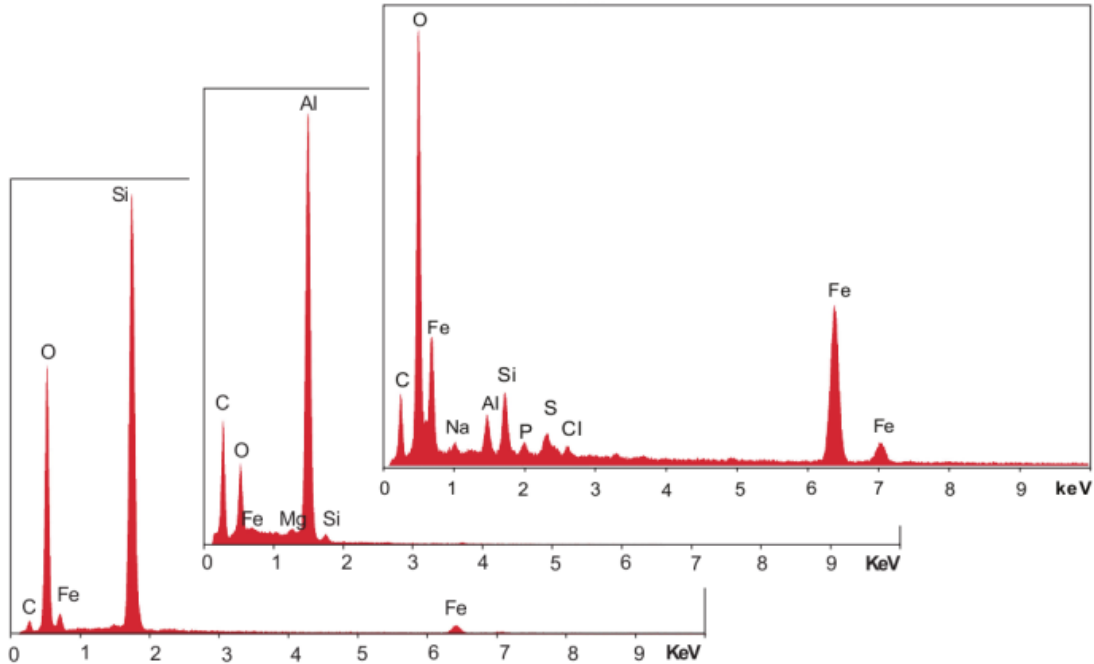
- The red layers contain abundant [aluminum](#), iron, and oxygen, where the iron is associated with oxygen, and the aluminum is mostly in a pure, elemental, form.
- The relative quantities of aluminum, iron, and oxygen match those of the most common [thermite](#) formulation: $\text{Fe}_2\text{O}_3 + 2 \text{Al}$.

The chemical composition of the chips is established by measuring the levels of elements in the chips' constituent parts. Using a [scanning electron microscope](#) equipped with [X-ray energy-dispersive spectroscopy \(XEDS\)](#), it is determined that each of the two types of particles in the red layer, as well as the porous material holding them, has a specific elemental composition.



This is the chemical equation of the most common type of thermite reaction: Two atoms of aluminum react with a molecule of iron oxide to form a molecule of aluminum oxide and two atoms of iron. Because the aluminum holds the oxygen much more tightly than does the iron, the reaction releases a great deal of energy -- about three times as much per unit of weight as is released by conventional high explosives.

Active Thermitics Made Simple



A collage of Figs. 16, 17, and 18, showing, from back to front, the spectra from a silicon-rich region on the porous red matrix, a region with a clump of the aluminum-rich thin plates, and a region with a clump of the iron-rich grains.

- The flat plates are mostly [aluminum](#). Because the other elements are present in much smaller quantities, most of the aluminum must be in its (unstable) elemental form, unbound to oxygen and ready to react.
- The faceted grains are mostly iron and oxygen in the ratio of the Fe_2O_3 form of iron oxide, a compound that readily gives up its oxygen to aluminum once the reaction is started.

Thus, the two types of nano-particles in the red layer contain the two ingredients of [thermite](#): pure aluminum and iron oxide. Furthermore, the red-layer matrix in which the particles are embedded in a highly uniform manner is mostly silicon and oxygen -- similar in composition to known variants of [nano-thermite](#) optimized for high explosive pressure.

Although these elements -- aluminum, iron, oxygen, and silicon -- were all abundant in building materials used in the Twin Towers, it is not possible that such materials milled themselves into fine powder and assembled themselves into a chemically optimized aluminothermic composite as a by-product of the destruction of the Twin Towers.

>> [FURTHER READING: chemical composition of the chips](#)

3. Thermal Behavior

- When the chips are heated to about 430°C (806°F), they undergo a runaway chemical reaction producing temperatures of at least 1535°C (2795°F) -- the melting point of iron.
- The residues produced by these reactions -- iron-rich spheres -- match those produced by igniting commercial [thermite](#) and particles found in WTC dust samples.

Active Thermitics Made Simple

The thermal behavior of the chips is analyzed using an instrument (a [DSC](#)) that measures the flow of heat into and out of the sample as its temperature is gradually increased. When the samples are elevated to about 430°C, they ignite in a run-away reaction that reaches at least 1535°C. The fact that the reaction reaches those very high temperatures is evident from the reaction's residue of minute solidified iron-rich spheroids -- residues that had clearly experienced temperatures above the melting point of iron to create molten droplets that became spherical under the influence of surface tension.

The iron-rich spheroids formed by heating the chips in this manner match those found in abundance in all of the samples of WTC dust studied, and those produced by the reaction of commercial thermitite, both in appearance and in chemical composition revealed by [XEDS analysis](#).

A measure of a pyrotechnics' performance is its [energy density](#): how much energy can be packed in a given weight or volume. Estimates of the energy densities of chips ignited in the [DSC](#) shows them to be similar to those of conventional high explosives and conventional [thermite](#). These estimates include the weight of the inert gray-layer material, which may account for the range of energy densities of the four different chips.

Whereas structural and chemical analysis of the chips shows that they were designed as some kind of [pyrotechnic](#), thermal analysis shows that, despite their fragmented form and age, are still *active pyrotechnics*, and ones with impressive [energy densities](#).

[Active Thermitic Material Discovered](#) does not describe tests that might indicate the discovered material's [power density](#). The fact that it ignites somewhere between 370°C and 430°C would seem to make it a delicate explosive, since an office fire can generate such temperatures. However, the material might have more than one reaction mode: It might be designed so that the more gradual heating by a fire causes it to [deflagrate](#) and appear to burn like a hydrocarbon material; whereas the small spot of extreme temperature provided by a micro-detonator causes it to [detonate](#) with a shockwave powerful enough to shatter objects several feet away.

Although building rubble can contain flammable materials, it is not possible that legitimate materials in the Twin Towers or residues of them formed in the buildings' destruction would be capable of reacting to produce temperatures above the melting point of iron.

>> [FURTHER READING: thermal behavior of the chips](#)

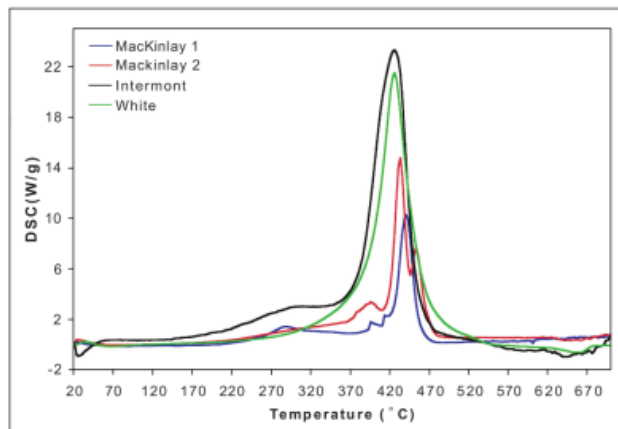


Fig. 19 compares the DSC traces of a chip from each of the four samples. Although a trace does not capture the increase in temperature once a sample ignites, the area underneath it approximates the sample's [energy density](#).

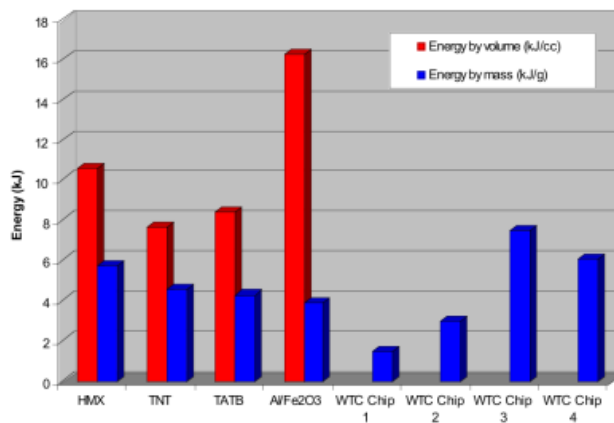


Fig. 30 compares estimates of the energy densities of four chips to those of high explosives and thermitite.

Conclusion

As this simplified summary of the findings of the paper [Active Thermitic Material Discovered in Dust from the 9/11 World Trade Center Catastrophe](#) shows, the distinctive red-gray chips found consistently in dust samples from the destroyed Twin Towers are clearly an advanced engineered [pyrotechnic](#) material. It is not even remotely possible that the material could have been formed spontaneously through any random process such as the total destruction of the Twin Towers. Nor is it possible that the material was present in the Towers for some innocent reason.

The chips are clearly the unexploded remains of a pyrotechnic material -- likely a high explosive -- that was present in the Twin Towers in large quantities. Reasonable estimates of tonnage of material based on the abundance of red-gray chips in the dust range from the tens into the hundreds. Although the installation of so much material would require considerable planning and logistics, it would not necessarily be difficult to conceal, as this [hypothetical blasting scenario](#) shows.

The progressive [detonation](#) of so many tons of energetic material would explain the mushrooming explosions that so systematically shattered each Tower from top to bottom, and the incredible thoroughness of the destruction, which left virtually no recognizable building components other than the heavy steelwork and cladding, and no traceable fragment of [more than 1000 human bodies](#).



The North Tower is consumed in a vast eruption as would be produced by a choreographed cascade of thousands of small blasts.

Glossary

aluminothermic: Synonymous with [thermitic](#) but specifying that the fuel is [aluminum](#).

aluminum: The thirteenth element in the periodic table and most abundant metal in the Earth's crust, though almost never in its elemental form due to its high reactivity. Because it reacts so energetically, aluminum is the fuel of choice for many [pyrotechnics](#).

deflagration: A reaction process that propagates through heat and thereby produces a fast burn.

detonation: A reaction process that propagates through a rapid (supersonic) pressure wave and thereby produces an explosion.

differential scanning calorimeter (DSC): An instrument that measures the thermal energy absorbed or released by a sample as a function of its temperature.

energetic material: A material that stores a large amounts of chemical energy whose release is triggered by specific conditions. The use of [nano-engineering](#) to create energetic materials meeting highly specific design requirements has been an active area of research since the mid-1990s.

energy density: The ratio of an [energetic material](#)'s stored energy to its weight or volume.

nano-composite: A manufactured material consisting of several component materials assembled on scales of a few hundred [nanometers](#) or less.

nano-engineered: Constructed at the atomic or molecular level, generally at 100 nanometers or smaller.

nanometer: Unit of length equaling one-billionth (1/1,000,000,000) of a meter. Most atoms measure between 0.1 and 0.5 nanometers across.

nano-particle: A particle, at least one of whose dimensions is 100 [nanometers](#) or less. Because of their extremely small size, the manufacture of nano-particles requires expensive, specialized equipment and know-how.

nano-thermite: An advanced type of [thermite](#) in which the fuel (aluminum) and oxidizer (iron oxide) are in the form of intimately mixed [nano-particles](#), generally embedded in a durable matrix.

power density: The ratio of an [energetic material](#)'s rate of energy release to its weight or volume.

pyrotechnic: An [energetic material](#), typically composed of finely divided metallic fuels and oxidizer powders held in a binder, that undergoes a self-contained reaction producing an engineered mix of light, heat, and pressure. Although most often used to describe fireworks and propellants, pyrotechnics have broad military applications ranging from incendiaries to high-explosives.

scanning electron microscope: A kind of microscope used to produce very high-resolution images of a sample's surface by scanning it with an electron beam.

thermitic: Having the characteristics of [thermite](#), and thus the ability to release large amounts of energy on ignition.

thermite: An [energetic material](#) that, when ignited, releases large amounts of energy through a chemical reaction in which oxygen is transferred from an oxidizer (such as iron oxide) to a fuel (such as aluminum).

X-ray energy-dispersive spectroscopy (XEDS): A method of measuring the relative proportions of elements within particular parts of a sample by analyzing the spectrum of X-rays emitted as an electron beam is directed onto the sample's surface.