Welcome to the Diamond Age of Power

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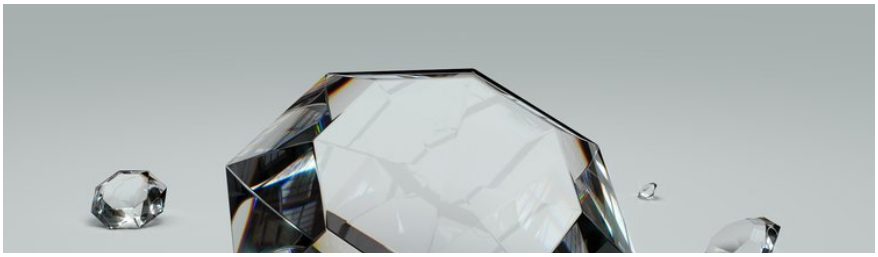

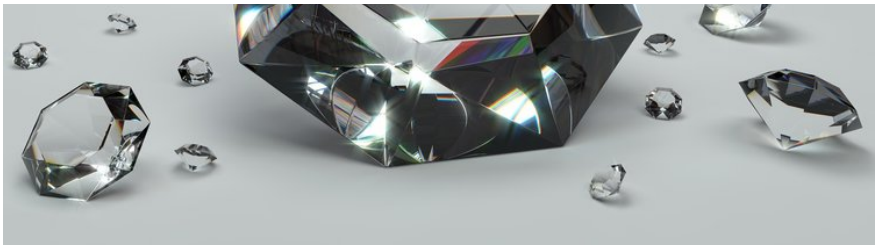

Storing and monitoring nuclear waste, which can take thousands to millions of years to become non-radioactive, is a costly challenge. Chemists and physicists from the University of Bristol have developed an ingenious method of using up some radioactive waste and also creating a long-lasting, clean energy source: a man-made nuclear diamond battery. What a beautiful solution!

A video released by the university explains that since the 1940s, the UK has run many nuclear reactors for research, military purposes and electricity generation. Britain's Magnox reactors are now being decommissioned and 104,720 tons of radioactive blocks are leftover. The blocks are made of graphite and were used to control reactions in the cores of the reactors. The blocks became radioactive over the years and now contain a layer of radioactive carbon-14 on the sides that were closest to the uranium rods.

Nuclear waste that is released into the environment can lead to extensive soil and groundwater contamination, affecting entire ecosystems. Carbon-14's radioactivity is only powerful enough to penetrate a few centimeters but is still considered too toxic to be let loose in the environment. What the scientist have discovered is that they can make the blocks less radioactive and easier to store by heating them to drive out the radioactive carbon-14, which it turns out can be very useful in diamond battery production.

Man-made carbon diamonds are able to produce a small electrical current when they are exposed to radiation. Knowing this, scientists set out to create a safe man-made diamond battery made of radioactive material in order to increase this electrical output. By applying the right amount of low pressure and high temperature to the carbon-14 gas, they successfully created a man-made diamond.

“Carbon-14 was chosen as a source material because it emits a short-range radiation, which is quickly absorbed by any solid material,” said Dr. Neil Fox, one of the chemists. He also pointed out that because diamonds are the hardest substance we have ever discovered, they offer optimum protection. Once the diamonds are made, they are given an extra coating of non-radioactive diamond material, which makes them even safer and almost 100 percent efficient. The University of Bristol explains that the radiation that is then given off is less than what a single banana emits!

This type of creative transformation of nuclear waste into a useful clean energy source could be very beneficial in the U.S., where there are 99 nuclear reactors currently running. Big Think explained that typical nuclear power plants can create around 2,300 tons of waste each year. Storing this waste is risky for the environment and costly—Politico reports the annual U.S.cost to be around $38 billion and rising in 2013.

The second amazing feature of this battery is its lifespan. It takes carbon-14 5730 years to lose half of its radiation and therefore half of its power. So, the study claims, the battery will take about as long as the entire span of human civilization to become half as efficient.

Engadget points out that the high cost of diamond is one potential issue with the large-scale application of these batteries. The batteries are also considered to be relatively low-powered and produce 15 Joules per day (less than one AA battery). But, given their longevity, they still have a wide variety of potential applications.

"We envision these batteries to be used in situations where it is not feasible to charge or replace conventional batteries," explained Tom Scott, a professor in Materials who is working on this groundbreaking development. "Obvious applications would be in low-power electrical devices where long life of the energy source is needed, such as pacemakers, satellites, high-altitude drones or even spacecraft.”

The importance of having a long-running battery in space was illustrated by the European Space Agency's 2014 Rosetta mission,

which successfully landed a probe on Churymov–Gerasimenko, a Jupiter-family comet, but could only send 64 hours of data before the battery died. Nuclear or atomic batteries have been created by NASA and other space agencies in the past and NASA has used them in over 25 missions. Stanford explained that the principle advantages of of atomic batteries are that they are long-lasting and low maintenance.

A third benefit of these new batteries is that, when completed, they are small, simple (containing one singular component) and environmentally safe. Cabot says, “there are no moving parts involved, no emissions generated and no maintenance required, just direct electricity generation. By encapsulating radioactive material inside diamonds, we turn a long-term problem of nuclear waste into a nuclear-powered battery and a long-term supply of clean energy.”

Initial prototypes have now been completed with another radiation source, the unstable isotope Nickel-63, which creates a battery with a half-life of a century (far less than carbon-14’s 5730 years). The carbon-14 prototypes are now in development.

This project was presented by Scott to sold-out crowds at the University of Bristol’s Cabot Institute’s fall 2016 “Ideas to Change the World” lecture series. Bristol University shared that this groundbreaking technology is “truly taking us into the diamond age of power generation.”

To stay updated on this project, connect with the university on Facebook and Twitter. The British team is so excited to get everyday people’s feedback and ideas about how the batteries could be used, they’ve created a social media campaign centered on #diamondbattery. Ideas mentioned online so far include using the batteries in standard vehicles, clocks, weather buoys, security lighting, interstellar probes, emergency generators, hearing aids and flying cars. FLYING CARS!

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