'Diamond-age' of power generation as nuclear batteries developed

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Credit: University of Bristol

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This innovative method for radioactive energy was presented at the Cabot Institute's sold-out annual lecture - 'Ideas to change the world'- on Friday, 25 November.

Unlike the majority of electricity-generation technologies, which use energy to move a magnet through a coil of wire to generate a current, the man-made diamond is able to produce a charge simply by being placed in close proximity to a radioactive source.

Tom Scott, Professor in Materials in the University's Interface Analysis Centre and a member of the Cabot Institute, said: "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."

The team have demonstrated a prototype 'diamond battery' using Nickel-63 as the radiation source. However, they are now working to significantly improve efficiency by utilising carbon-14, a radioactive version of carbon, which is generated in graphite blocks used to moderate the reaction in nuclear power plants. Research by academics at Bristol has shown that the radioactive carbon-14 is concentrated at the surface of these blocks, making it possible to process it to remove the majority of the radioactive material. The extracted carbon-14 is then incorporated into a diamond to produce a nuclear-powered battery.

The UK currently holds almost 95,000 tonnes of graphite blocks and by extracting carbon-14 from them, their radioactivity decreases, reducing the cost and challenge of safely storing this nuclear waste.

Dr Neil Fox from the School of Chemistry explained: "Carbon-14 was chosen as a source material because it emits a short-range radiation, which is quickly absorbed by any solid material. This would make it dangerous to ingest or touch with your naked skin, but safely held within diamond, no short-range radiation can escape. In fact, diamond is the hardest substance known to man, there is literally nothing we could use that could offer more protection."

Despite their low-power, relative to current battery technologies, the life-time of these diamond batteries could revolutionise the powering of devices over long timescales. Using carbon-14 the battery would take 5,730 years to reach 50 per cent power, which is about as long as human civilization has existed.

Professor Scott added: "We envision these batteries to be used in situations where it is not feasible to charge or replace conventional batteries. 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.

"There are so many possible uses that we're asking the public to come up with suggestions of how they would utilise this technology by using #diamondbattery."

Provided by University of Bristol

https://phys.org/news/2016-11-diamond-age-power-nuclear-batteries.html