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News & Analysis

RPI claims battery-fueled, room-temp fusion

R Colin Johnson

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Portland, Ore. -- It won't power the starship Enterprise, but an experimental "dilithium crystal" pyroelectric technology is said to enable compact nuclear fusion.

Engineers at Rensselaer Polytechnic Institute (RPI) have charged centimeter-sized lithium tantalate crystals to act as a battery at room temperature.

"In a [conventional] fusion device designed to produce energy, the plasma is further heated to sustain the reaction, but we cannot use it to sustain the reaction," says associate professor Yaron Danon.

"Instead, we plan to use the energy emitted to create applications in non-destructive testing or, possibly, in medical applications."

Indeed, Danon predicts that different applications could include accelerating energy particles that a pyroelectric crystal accelerates neutrons and X-rays. The electrons that pyroelectric crystals emit for therapeutic purposes, such as cancer treatments, energy emissions might be used to inspect cargo.

Danon performed his research for the Department of Nuclear Engineering at RPI. He is a doctoral candidate in nuclear engineering.

How it works

In the traditional fusion-reactor, high temperatures are used to create a superheated plasma. Instead of millions of degrees, dilithium-crystal fusion uses 100-kilovolt (deuterium) molecules onto a target, achieving nuclear fusion at or low-temperature cryogenic cooling.

The fusion device depends on the piezoelectric-like property of the crystals. When the crystals are heated (or cooled), they induce a 100,000-volt electric field. The crystals are an insulator, but their lattice structure responds to heat. On one side of the crystal, leaving behind positively charged ions.

"When you heat or cool the crystal . . . it becomes a piezoelectric. The crystal is an insulator, when it becomes polarized, a voltage output is the charge, which is big, divided by the area, thereby making the voltage swing huge--over 100,000 volts."

Traditional portable neutron sources are at least a supply that can deliver 250,000 electron-volts. In a 200,000-V electric field by opposing two pyroelectric crystals. Whenever the pyroelectric crystals are heated or cooled, they naturally produce the high-voltage field.

"We don't require external high-voltage power supply. It takes only a few watts to heat the crystal to get its high-voltage output. Our device is only about 15 x 15 centimeters, and we predict our next-generation device can be much smaller, only about 2 x 1 cm."

By using the field to accelerate deuterium oxide a few millimeters, engineers fused two deuterium atoms into helium, releasing neutron particles--the hallmark of nuclear fusion.

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