13.56 MHz as a Cancer Cure? It Just Might Be...

A ham's ingenuity and nanotechnology join forces to fight cancer.

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In the past months there has been a lot of publicity about John Kanzius and a possible method of destroying cancerous tumors in humans using RF energy and nanoparticles. Animal tests look very good and human testing is on the fast track. But who is he and how does radio fit in?

John Kanzius is a ham, K3TUP, and a cancer survivor. He loves to build what he calls "exotic antennas" at his station including stacked rotating beams and a rotating tower with multiple beams. According to John, many well-known contesters won worldwide contests from his Western Pennsylvania site as guest operators.

"Trying to build an array that would heat particles one billionth of a meter in length was challenging."

Retirement Interrupted

John also is a broadcast engineer who acquired ownership of several radio and TV stations, then sold them as a group and retired to a life of leisure on Sanibel Island, Florida — or so he thought. That dream was destroyed in 2002 when he was diagnosed with leukemia.

In between trips to his doctors, he saw the devastation cancers have on human beings and the horrors of chemotherapy's side effects. Despite the advances in pharmacology and surgery, "cancer" was still a terrifying word. John summarized the slow downward spiral caused by the effects of treatment that engulfed many lives, including his own, as "…hoping we kill the cancer before we kill the person."

Original couplers at M. D. Anderson Cancer Center.

M. D. Anderson Cancer Center external RF system generator.

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John Kanzius, K3TUP, with generator.

John and his wife Marianne (known as MAK) with actor Peter Fonda.

Late Night Idea

In October 2003 John had an idea — kill cancer cells with radio waves. As every ham knows, radio energy (RF) can heat objects. This was not a new idea and had been tried before with poor results. Previous attempts, using a process called "ablation," used needles inserted into the patient as the targets for the RF energy. The energy would heat up the needles and cook the tissue surrounding the needle. The problem was that it (a) used needles and (b) cooked everything, both good and bad cells. But John's idea went further — and this is where the inspiration came. What if, instead of needles, the cancer cells were "tricked" into taking a metal target *inside* just the tumor cells?

Like many of us who have great ideas in the middle of the night, it sounded good to him. But unlike most of us, he did not wait until morning. Rather than run the risk of losing the concept in his sleep, John immediately got up in the dark and began work on possible antenna designs by cutting up his wife's pie pans. Hearing the strange noises in the night, his wife, Marianne, shrieked "What the hell are you doing?"

John's first attempts used copper sulfate, and his first "patient" was a hot dog. But it seemed to work and gave him the confidence to start asking questions of doctors in the field. The next steps were to interest scientific researchers in the concept, build a special transmitter that could safely focus the RF energy, test it out on real tumors, find ways to trick cancerous cells into absorbing the RF target and see if it really was "too good to be true."

Another Piece of the Puzzle

A much better RF target was presented in 2005 when his personal physician brought him into contact with Dr Steven Curley, a professor at the M. D. Anderson Department of Surgical Oncology at the University of Texas. Dr Curley found the process promising and brought a present — "nanoparticles."

Nanoparticles are incredibly small objects, usually metallic, measured in billionths of an inch. If the tumor cells could be made to take these particles internally, and if they could then be heated up with RF, would that kill off the tumor or the patient?

"The research scientists at Rice were stunned to see that my device could heat nanoparticles at the 13.56 MHz frequency."

John built a special RF generator for the project. As John says, "Trying to build an array that would heat particles one billionth of a meter in length was challenging. But building equipment all of my life was inspired by my dad, W3NRE, who was licensed in 1934."

Things Get Hot

As for attracting serious researchers, John attracted the interest of Dr David Geller, a co-director of the University of Pittsburgh Medical Center liver cancer program. In 2005, John, Marianne, Curley and Geller put it all together for the first time in a laboratory at the University of Pittsburgh. John's special RF generator targeted a tube of carbon nanoparticles in a solution. John had the honor of pressing the switch, and within seconds the solution began to boil.

Dr Curley knew they were on to a major event in medicine: "We could target specific abnormal proteins, put a polar charge on the nanoparticles and use magnets to focus them on those areas of the tumor."

Dr Richard Smalley (SK), a Nobel laureate and also a cancer patient, was Rice University's expert in nanoparticles and especially "fullerenes," which are made of carbon and include tube shaped particles called "nanotubes." When Dr Curley first reported to Dr Smalley that he actually had seen carbon nanoparticles get very hot when in the beam of John's RF generator, Dr Smalley is reported to have grasped the importance immediately and exclaimed, "Holy God!"

John is more modest about it and simply writes, "The research scientists at Rice were stunned to see that my device could heat nanoparticles at the 13.56 MHz frequency."

Dr Smalley spent the rest of his working days on the project because he believed that this is indeed the breakthrough that is hoped for by so many millions. Dr Boris Yakobson continues the work at Rice.

The Rabbit Didn't Die

Initial animal testing done at Rice University used rabbits. Being careful that all scientific methods were followed and complete with several control groups, a solution containing carbon nanotubes was injected into cancerous tumors in rabbits. The rabbits had either pancreatic cancer or liver cancers. Four rabbits were the primary test animals for the experiment. After the injection, they were put into the special RF field created by John's RF generator for two minutes. The results were checked 48 hours later. The tumors in all four had been destroyed by heat, but there was very little damage to neighboring tissues as close as 2 to 5 mm away.

Science is an exacting discipline. Every aspect of a clinical trial, let alone a revolutionary finding like this one, must withstand

Carbon Nanotube-Enhanced Thermal Destruction Of Cancer Cells In A Noninvasive Radiofrequency Field

While this scientific paper is quite complex, here's a brief "translation."

There have been past attempts to treat cancers and related tumors using RF energy. Most of these past attempts involved inserting needles into the tumors and using RF to heat the needles which then killed any cells in proximity to the needle, both good and bad.

The excitement in John Kanzius' work is the demonstrated ability to target the RF energy to specific locations by use of Single-Walled Carbon Nanotubes that release heat energy in an RF field. SWNTs are incredibly small cylinders with walls one atom thick. Using water-soluble SWNTs and injecting them into the tumor, the nanotubes are taken up by the tumor cells. Then, using a 13.56 MHz RF field and between 400 and 1000 W, researchers were able to heat the nanotubes, killing the tumor cells while not harming normal cells.

The RF generator is connected to a high Q coupling system with transmitter (TX) and receiver (RX) heads that can be swiveled as needed to orient the RF direction. The distance between the TX and RX heads is adjustable, which allows changes to the field size, shape and density. Tests commonly use an RF field diameter of about 30 cm.

The animal studies that have been completed used carbon SWNTs injected into a group of rabbits with tumors. The results were that there was "total cell necrosis of the tumors" while the animals had no side effects. Current research is looking into ways to use gold SWNTs coupled to other chemical agents that will only be absorbed by cancerous cells, allowing many more delivery options. There are several agents possible for this and hopes are high that it can be done.

Hams will note that the nanotubes are very small. The carbon ones are about 20 nm (that's 20 billionths of a meter) and the new gold ones are only 3 to 5 nm. Meanwhile the wavelength of 13.56 MHz is even longer than our 20 meter band. John reports that he has devices on multiple frequencies of 13.56 MHz and chose that because it and its harmonics are frequencies assigned by the FCC for industrial applications. In this way he was certain not to be interfering with other services and his preliminary tests showed the human body to be transparent to that frequency.

There are currently several theories for the resonance of the nanotubes despite the disparity between size and wavelength. The most supported one is that in an RF field the nanotubes organize themselves in some way, much like iron filings in a magnetic field. They form chains that hit upon a frequency multiple, achieve resonance and heat up. In short, a "self-assembling antenna"!

The next steps are human studies and using agents that will deliver the nanotubes to tumor cells but not healthy cells. For this step they will shift to the use of gold nanotubes instead of carbon because gold nanotubes have already been approved by the FDA for human use. All in all, if it proves out, this could be an easy golden pill to swallow and it sure beats chemotherapy!

extensive peer review and be published for others to test and duplicate. In September 2007 John learned that the paper he co-authored[1] had been accepted and would be printed in *Cancer*, a major oncology medical journal published on behalf of the American Cancer Society.

The Future

Unfortunately, even though *in vivo* animal tests and human cancer cells on petri dishes have been destroyed by this method and the technology is on "fast track," actual experiments with living human cancer patients still may be three years away. Meanwhile Kanzius has been bombarded with offers and people wanting to negotiate with him for the rights to his invention.

Work continues to progress on the procedure at M. D. Anderson, the world's largest cancer research center. John wisely patented his RF generator and formed Therm Med, LLC. He now has his RF generators being made in a factory, so his wife's pie pans are safe again. John is obviously optimistic about it all and credits his Amateur Radio experiences as a fundamental part of the invention process.

"If it were not for ham radio and all the days of experimentation to improve my station, this new procedure for treating cancer, which continues to show such promising results, would probably not be on the cutting edge at the largest cancer center in the world."

In the past months others have also become excited as positive results pile up.

A personal note: My family also has experienced the tragedy of cancer. Who among us has not? We hope, bargain and pray for a miracle, and often only find disappointment. But ***this*** time…maybe…We are rooting for you, John.

"...hoping we kill the cancer before we kill the person."

John Kanzius, K3TUP

Notes

[1]The primary scientific paper, *Carbon nanotube-enhanced thermal destruction of cancer cells in a noninvasive radiofrequency field,* was published online on October 24, 2007 (**www3.interscience.wiley.com/cgi-bin/abstract/116834125/ABSTRACT**) and copyrighted by The American Cancer Society. It is to appear in an upcoming issue of their journal, *Cancer*. It was written by:

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All photographs courtesy John S. Kanzius, K3TUP.

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