Diamond technology to revolutionize mobile communications

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The U. S. Department of Energy's Argonne National Laboratory has teamed with industrial and academic partners under a DARPA Phase II research and development program to develop a new technology based on Ultrananocrystalline Diamond™ (UNCD), a novel material developed at Argonne that will enable diamond resonators and oscillators to be directly integrated with microelectronics chips for next-generation telecommunication devices.

DARPA– the Defense Advanced Research Project Agency – is funding the work for advanced telecommunications systems to be used in both military and civilian applications. These devices will be fully integrated with silicon microchips to enable a new generation of high performance portable communication systems. Eventually the fruits of this project could result in enabling a variety of mobile technologies with much higher data communication rates.

Diamond is the hardest known substance on earth. In addition, since diamond is both stiff and light, it can be used to produce tuning fork devices (tiny diving board-like structures which oscillate at high frequencies to receive and transmit signals) that vibrate at frequencies higher than similar devices of the same dimensions made of other materials—up to 100,000,000,000 times per second for diamond tuning folks that are around 100 nanometers in size. Such high frequency structures can be used as key electrical elements in cell phones, enabling them to operate at much higher frequencies. The challenge is to manufacture diamond tuning forks reliably and affordably enough for

them to be widely adopted in broadband communication devices.

The four partners in the research project each bring particular expertise to the effort. Argonne provides the worldwide leading fundamental and applied science on the patented UNCD film technology developed over the last 14 years. Advanced Diamond Technologies, Inc. (ADT), a spin-off company from Argonne, is developing UNCD thin films for a number of applications, including the deposition of low-temperature films on large-area (200 mm) silicon wafers that is critical to the success of the current program. Innovative Micro Technology (IMT) has the largest and best-equipped independent MEMS fabrication facility in the world and provides MEMS services from design through production. The University of Wisconsin-Madison has advanced microfabrication facilities at the Wisconsin Center for Applied Microelectronics, and provides novel atomic force microscopy tools to characterize UNCD-based MEMS device performance. The DARPA Phase II program is funded at $1,400,000 for 12 months.

“The UNCD technology developed and patented at Argonne, and transferred to ADT for commercialization, provides the basis for a new generation of commercial MEMS devices,” said Orlando Auciello, Argonne Senior Scientist and Principal Investigator of the DARPA-funded program. “UNCD exhibits exceptional mechanical and low surface friction properties that are far superior to the current silicon materials used in most MEMS devices. The team has already discovered in a Phase I of the project that UNCD exhibits the highest known acoustic velocity, which directly translates to high resonator frequencies. Both the frequency and the quality factor of these resonators are unaffected by environmental exposure, which are key requirements for real MEMS devices. The funding from DARPA is key to the challenging undertaking of developing a whole new MEMS technology based on the novel UNCD material.

Source: Argonne National Laboratory