Iridium is attractive for improving flash memory chips

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One of the rarest metals on Earth may be an excellent option for enabling future flash memory chips to continue to increase in speed and density, according to a group of researchers in Taiwan.

"Incorporating nanocrystals of iridium into the critical floating gate portion of flash memory designs shows both excellent memory properties as well as stability in the high temperatures used in processing such semiconductor devices," says the research team leader, Wen-Shou Tseng of Taiwan's Center for Measurement Standards, Industrial Technology Research Institute. The research results appears in the journal Applied Physics Letters, which is published by the American Institute of Physics. His colleagues included students and professor at the nearby National Chiao Tung University and Chung Hua University.

This team chose iridium -- a hard, dense and corrosion-resistant metal in the platinum family that is one of the rarest metals found in the earth's crust -- because unlike most alternatives, it has two desired properties: Iridium holds its electrons strongly (it has a high "work function", which is well-known to correlate with excellent memory properties), and its melting point of nearly 2,500 degrees Celcius is well beyond the 900 C annealing temperature that many chips must survive during manufacturing. Fortunately only a billionth of a billionth of a gram of iridium would be needed for each gate.

Researchers worldwide are investigating new ways to improve the popular flash memory, which is the nonvolatile memory chip design used

in virtually all digital cameras and mobile electronics and, increasingly, in solid-state drives for laptop computers. The easiest way for future flash memories to hold more data and read/write faster, is to shrink the dimensions of the existing chip design, including the floating gate. But today's gate design has already progressed to the point where it cannot get much smaller before it can no longer retain the electrical charges that actually store the data. Nanocrystals have been proposed as a rather simple change that can improve memory chip performance without changing the tried-and-true floating-gate design.

In recent years, many different metals have been investigated for their nanocrystal potential. Nickel and tungsten, for example, are attractive for, respectively, a high work function and thermal stability. But they and other elements lack both needed properties. It is rare, indeed, that iridium has both needed qualities, Tseng says.

More information: The article, "Formation of iridium nanocrystals with highly thermal stability for the applications of nonvolatile memory with excellent trapping ability" by Terry Tai-Jui Wang, Chang-Lung Chu, Ing-Jar Hsieh, and Wen-Shou Tseng appears in the journal *Applied Physics Letters*. See: link.aip.org/link/applab/v97/i14/p143507/s1

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