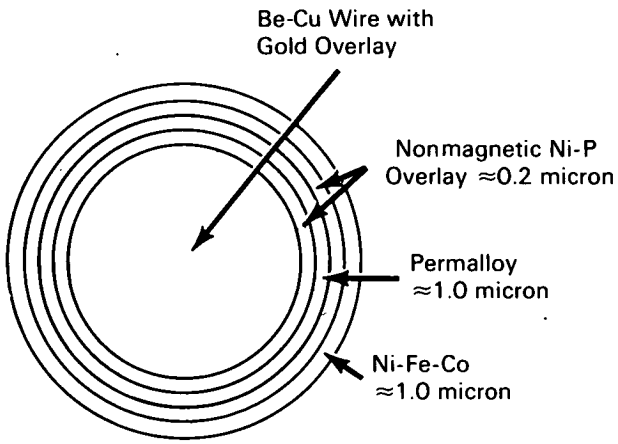
NASA TECH BRIEF

Multilayer Plated Wire Shows Promise as Memory Device



Advanced memory systems are needed in modern computer technology to keep abreast of constant improvements being made in electronic circuitry and packaging techniques. The plated wire memory in particular appears most attractive because of its high output compared to planar thin film memories and also because of its high speed and simplicity.

Basically, the device consists of 5 mil Be-Cu wire plated with an 81% Ni-19% Fe alloy about 1 micron thick crossed orthogonally by word lines. The distinguishing feature is the easy axis orientation along the circumference of the wire in a closed flux configuration. The resultant low demagnetization value in the remanent state permits relatively thick films to be used. Since the amplitude of the output is directly proportional to the volume of the material and thus to the thickness of the element, a relatively thick plated wire device is capable of outputs from 15 to 50 mv in the destructive mode and on the order of 3 to 10 mv in the nondestructive mode.

Operation of a plated wire device is similar to the operation of a single flat film in many respects. Application of a word current causes the magnetization vector to rotate toward the hard axis with the polarity of the output signal identifying the stored bit, and the central Be-Cu wire serving as the sense line. The closed flux configuration of the plated wire device enables its magnetization to be rotated to an angle smaller than 90°. Upon termination of the next read current, magnetization returns to the original state, thus providing a nondestructive readout.

Writing is by the driving of a small write current of appropriate polarity through the Be-Cu wire prior to terminating the "read" current, in a manner identical to the steering of flat films. Because the plated wire is capable of both writing and reading speeds in the submicrosecond region, it can be used with equal ease in scratch pad or program store applications.

A multilayer plated wire of cross section as illustrated has been used experimentally with promising

(continued overleaf)

results. High-coercive force Fe–Co is plated over Ni–P preplate. An additional layer of Ni–P is plated and a low-coercive force Permalloy is plated over this Ni–P. The coercive force of the Fe–Co is designated by H_c and the low coercive force of the Permalloy by H_{cl} so that $H_c >> H_{cl}$. Bit information is written into the Fe–Co layer which acts as a steering mechanism for the Permalloy layer switching it into a "1" or "0". A low amplitude current pulse is applied, when reading information, which does not switch the Fe–Co layer (because of its high-coercive force) but does switch the low-coercive force Permalloy. The Permalloy is, therefore, always switched in the direction of the Fe–Co layer with Co acting as a keeper.

Notes:

1. This device appears superior to the conventional single layer permalloy-plated wire wherein, while operating in the nondestructive mode, the magnetization vector, by rotating through an angle approaching 90°, can destroy the written information.
2. Inquiries concerning this experimental investigation may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   Houston, Texas 77058
   Reference: B68-10205

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: Donald Kadish
of Massachusetts Institute of Technology
under contract to
Manned Spacecraft Center

(MSC-11587)