MEMORIES ARE MADE OF THIS

Since the coming-of-age of the personal computer, or PC, there has been a drive towards ever-increasing performance of these machines. Moore's law that computing power doubles roughly every eighteen months still holds remarkably true and as the performance of a typical PC improves, so do its memory requirements. From the 1980s when several kilobytes of data stored in a random access memory was considered to be fairly serious computing, internal memory storage has moved on to other technologies capable of storing hugely more data.

Growth in the consumer electronics market has combined with ever greater average numbers of hard disks per device to drive pgm usage higher in this sector.

As the demand for memory has increased, the technologies used to provide this have advanced, through floppy disks to hard disks and more recently to include other newer techniques such as flash storage. However, presently, the technology in widest use is the hard disk drive, something that has implications for the pgm market.

Hard drives themselves are an old technology in computer terms (they were developed in 1956) but they have become the industry-standard method of storing data. Amongst their advantages is that it is possible to read and re-write data huge numbers of times and, because the information is stored in the form of magnetic domains on the disk (small areas of parallel magnetisation), when the power is turned off, data is retained. Hard disks are now used in all personal computers and in a host of other devices. However, nothing in the IT industry remains untouched by progress and the hard disk has had to improve in performance and decrease in cost to keep its place.

Technological improvements on hard disks have mainly related to increasing rotational speed (the time taken to read and write data) and increasing the areal density (the amount of data that can be stored in a given area on the disk). However, over time, the performance of hard disks has approached a physical limit: as more and more data is written onto each square centimetre of disk, the magnetic domains tasked with storing this information decrease in size.

As the domain sizes get smaller, they become less stable and are prone to spontaneously changing their magnetisation (the superparamagnetic effect), leading to this information corrupting all too easily. In practical terms, this means that there is a limit to the amount of data that can be reliably stored on a disk. Electronics designers have taken a pragmatic approach to solving this problem: while they have researched new technologies, they have also simply increased the number of hard disks used per electronic device.

The first important development for the platinum group metals is the use of platinum in a number of the magnetic alloys used to store data. Mixing platinum with chromium alters the magnetic properties of this layer. Specifically, it increases the magnetic anisotropy (or directionality) of the media. This gives smaller domains, which are more stable, and therefore higher storage density hard disks. It also provides the opportunity for manufacturers to minimise the size of the technology, allowing it to fit into ever smaller form factors and miniaturised devices, something that has helped the hard disk to fit into cell phones and iPods.

The universal use of platinum in hard disks has combined with increasing sales of consumer electronics each year and the trend toward greater numbers of disks per product, to drive platinum demand higher for this application.

However, there are limits on how much data can be stored using even these methods. One of the next steps to improve performance

Ruthenium sputtering targets like those shown above are used in large numbers in the manufacture of new PMR hard disks.

was when IBM announced its "pixie dust" technology. This technology has been in production for several years and gives better areal densities than conventional hard disks.

Very thin layers of ruthenium are used as the filling in a sandwich of magnetic media. The benefit of these antiferromagnetically-coupled media (AFC) is that the ruthenium layer is the correct thickness to link two physically-separated magnetic layers. This coupling makes the read and write heads in the hard drive "see" a thicker, more stable layer. Each magnetic domain can take up a correspondingly smaller area of the disk surface while maintaining its volume and stability, and more data can therefore be stored.

However, this approach is fast being pushed out of the market by another newcomer: perpendicular magnetic recording (PMR). Again, the secret to this technology is to have each magnetic domain taking up as little of the surface of the disk as possible. In order to achieve this while keeping the domain large enough to prevent it spontaneously changing its magnetic state, the domain instead stretches into the disk, with magnetisation perpendicular rather than parallel to the disk's surface.

While the magnetic layer is made of much the same materials as in other more conventional hard disks (often an alloy of platinum and chromium) much of the magic is in how these layers are deposited. To this end, ruthenium layers, and a host of other materials, again come into use. Although the ruthenium layers are non-magnetic they act as spacers and seed layers for the rest of the structure, and are becoming widely used by many of the leading hard disk manufacturers. These layers are typically thicker than the so-called pixie dust.

The market share of this technology has recently been growing, with many new PMR products released in 2006. As a result, ruthenium consumption in hard disks has increased greatly over a short period.

The use of platinum group metals doesn't end there though. New designs of read heads, used to get information from a hard drive, contain iridium, alongside manganese and chromium. These heads are more sensitive and better at reading information. Although only tiny amounts of iridium are used in each, this does illustrate the usefulness of the platinum group metals throughout the area of memory storage.

Although hard disks are now clearly the dominant technology, the computer industry continues to develop quickly. USB flash drives, a rather different approach to data storage, are decreasing rapidly in price and the hard disk will have to improve to fight this threat to its dominance. Already, there is competition between these in some applications and this is likely to intensify. Other new technologies are on the distant horizon too. Nonetheless, almost all industry participants believe that the humble hard disk has a huge amount of potential yet. Hitachi, for example, sees improvements being made to PMR technology for many more years. And, with the platinum group metals used widely and for a range of purposes, there is every reason to forecast their continuing use.

The sputtering process physically deposits layers of materials such as platinum, ruthenium or base metals to form the complex structures required in a modern hard disk.