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Journal of Magnetism and Magnetic Materials 287 (2005) 1–8



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Development of perpendicular magnetic recording conference

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Available online 30 October 2004

Abstract

The early development of perpendicular magnetic recording and the activities of seven organized conferences on the subject are described. It is recognized that the present popularity of perpendicular magnetic recording is partly based on long and steady activities of the conferences. Valuable lessons from the research of perpendicular magnetic recording are also described. A long period is requested for the development of technologies from an invention to reach worldwide application is mentioned in relevance with the workings of human beings. A new classification of research work consisting of three cyclic research models is presented, which covers the culture as well as academic science and human society. It is concluded that integration is the keyword of all the work.

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PACS: 01.70.+w; 01.75.+m

Keywords: Perpendicular magnetic recording; PMRC; Historical view; New classification of research work

1. Beginning of perpendicular magnetic recording

The first speculation of perpendicular magnetic recording (PMR) dates back to the Kyoto Inter-mag in 1972, where the circular magnetization mode was suggested, then, the research of PMR was started with four important discoveries [1];

1. Perpendicular magnetization in magnetic tape (1974).

2. Co–Cr alloy film with uniaxial perpendicular magnetic anisotropy (1975).
3. The effect of double layer in perpendicular/longitudinal composite media (1978).
4. Complementarity between perpendicular and longitudinal recording (1979).

These discoveries really guided the beginning of PMR study. The fourth discovery of the complementarity between perpendicular and longitudinal recording is described in detail in Ref. [2] and the tutorial lecture of PMRC 2004 [3].

The first complete introduction of PMR by the American journal, *Electronics*, was made in 1982

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[4] as shown in Fig. 1, which was written by a famous writer, Mr. Charles Cohen. The article introduced Iwasaki as the inventor of PMR, namely the important discoveries for PMR; from the circular mode, through Co–Cr medium and double-layered recording media to the complementary relationship between perpendicular and longitudinal magnetic recording. The basic PMR system was developed by the end of 1976 with Co–Cr media and a single-pole recording head. The system performance was successfully improved by the double-layered media by 1978 and the guiding principle was discovered by 1980.

The intense impact of PMR on the field of magnetic recording of that time was well described by the word of Dr. D. Speliotis in an article of Electronics in 1982 [5] shown in Fig. 2. He stated, “There is an avalanche taking place, and we are sleeping over here.” The most striking influence would be the fact that Dr. Clark E. Johnson, Jr.,

IEEE Magnetics Society President at that time, asked the US government to fund translation service for Japanese technical journals [6] as shown in Fig. 3. He appealed, “The need for Japanese technical literature translation has become a vital and urgent matter” at the US House of Representatives in 1984.

2. Development of PMR and PMRC

2.1. Progress of perpendicular magnetic recording

Progress in development of PMR was as follows. From the latter half of 1980s to 2000; tribology studies on contact type (head and medium) recording, robustness studies to stray fields in single pole heads, and studies for low noise media and soft magnetic underlayers were performed intensively. While in the US,

Electronics / October 20, 1982

Iwasaki: inventor of vertical recording

Floppy-disk drives using vertical recording to achieve 10 times the density of present longitudinal-recording drives should hit the market next year. They will be the first of many products that incorporate the technology proposed at the 1977 Intermag meeting by Professor Shun-ichi Iwasaki of the Research Institute of Electrical Communication, Tohoku University, in Sendai, Japan. He predicts that “this will open an era of perpendicular recording that will last 30 years, just as the era of longitudinal recording lasted for 30 years.”

Iwasaki received his undergraduate and graduate degrees at Tohoku University and has been an assistant and then a full professor there for the past 25 years, spending his entire career working on high-density



recording techniques and theory.

His heavy theoretical studies positioned him to take full advantage of the potential of vertical—perpendicular, he says, is more descriptive—recording when the time came. In 1968, he developed a new theory of recording, including a theoretical quantitative computer analysis of internal magnetization. That was followed in 1972 by a model for a circular recording mode, which of course has a vertical component.

Iwasaki delved into optomagnetic recording, but it enabled him to develop the cobalt-chrome medium used in vertical recording. “Perpendicular magnetic recording is better,” he says, emphasizing the “magnetic.”

Back on his main track, Iwasaki developed the standard vertical-recording head, a double-layer medium, and a theory that supports this work. The head features a coil wound on a large auxiliary pole because a winding on the slender main pole—a stripe of magnetic material deposited on a nonmagnetic support—would saturate its tip. The double-layer medium has bits in the form of horseshoe magnets with attraction between poles, rather than the polar repulsion of longitudinal recording media.

Iwasaki says that theory shows that head, magnetization, medium, and all other aspects of perpendicular recording are complementary to longitudinal recording. And as it happens, “while longitudinal recording is suitable for analog signals, perpendicular recording is better for digital signals,” he comments.

In his leisure hours Iwasaki paints in oils. He says that “it is similar to my research because I must do the entire painting in parallel. One doesn’t complete one side and then move across the canvas.”

—Charles Cohen

Fig. 1. Comprehensive introduction of PMR in an American journal, Electronics [4]. All the important discoveries were covered as marked with underlines.

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