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Chaudhari P, Cuomo J J & Gambino R J. Amorphous metallic films for bubble domain applications. *IBM J. Res. Dev.* 17:66-8, 1973. [IBM Thomas J. Watson Res. Ctr., Yorktown Heights, NY]

A brief outline of the discovery of amorphous rare-earth transition metal films and their scientific and technological significance is presented. [The SO® **indicates that this paper has been cited over 165 times since 1973.]**

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"Magnetic bubbles are cylindrical domains which are used for storing information. During the early-1970s, I was responsible for managing the materials and physics activity of the bubble program at IBM. The storage medium that was being actively pursued at that time was a single crystal material called a garnet. The single crystal was difficult to fabricate without defects, which pinned the magnetic bubbles in an undesirable way.

"I had been thinking of amorphous materials as a way of avoiding the problems of crystalline defects in single crystals. During a scientific conference on amorphous materials away from the laboratory, Dick Gambino and I were wondering about the bubble program and alternative materials when he asked me about the possibility of using amorphous materials for magnetic bubbles. We discussed some of the materials requirements and concluded that we could probably induce bubbles in amorphous films provided we could get the required magnetic anisotropy. This is a nontrivial requirement as the amorphous solids are expected to have no preferred directionality. On our return to the laboratory we got together with jerry Cuomo and selected our trial material, a Gd-Co alloy. Gambino and Cuomo had already been involved in investigating this class of materials in the crystalline state as an alternative to crystalline garnets. They were in fact depositing these materials in the amorphous state and subsequently crystallizing them for bubble applications. Our activity in this field was at a very low level particularly since all of us were heavily involved in making the garnets work.

"During a program review with Ed Giess, a colleague of ours, and Ralph Gomory, the director of research, we discussed the problems with fabricating garnets, and I mentioned to Gomory that what we needed was to replace the garnet with an amorphous material. Gomory was excited about the possibility and urged me on. Armed with management enthusiasm and our own curiosity to see if it could be done, Cuomo, Gambino, and I pressed on to fabricating amorphous Gd-Co films.

"Within a short period we had made our first film and found, to our surprise, that the films showed magnetic bubbles. We did not need to induce magnetic anisotropy —it was already present. This observation opened the possibility of applying these alloys in computer memories as magnetic bubbles or as beam-addressable materials. The observation of magnetic anisotropy had raised an important scientific question, and a consequence of this observation was that a potentially new class of useful materials had been discovered. Much of the citation stems from the possibility of application or the scientific understanding associated with magnetic anisotropy in an amorphous material. B.C. Giessen, D. Turn-bull, and I recently published a paper in this field."[1]

1. Chaudhari P, Giessen B C & Turnbull D. Metallic glasses. *Sci. Amer.* 242:98-117, 1980.