NASA TECH BRIEF

Langley Research Center

Depositing Spacing Layers on Magnetic Film With Liquid Phase Epitaxy

Research conducted for Langley Research Center has revealed that liquid phase epitaxy can be used to deposit spacing layers on magnetic films. This consists of depositing, by liquid phase epitaxy, a thin film of $Gd_3Ga_5O_{12}$ on a ferrimagnetic garnet film, to provide a spacing layer between the garnet film and the Permalloy drive circuit used in magnetic bubble devices. The $Gd_3Ga_5O_{12}$ (GGG) spacing layer cannot be used if ion implantation is used to "hard-bubble proof" the magnetic film, as the effects of ion implantation would be destroyed as soon as the film is immersed in the solution. However, the liquid phase epitaxy GGG spacing layer is compatible with systems which are hard-bubble proofed by the use of a second magnetic garnet film as a capping layer.

The GGG substrate-magnetic film-GGG spacing layer composite is superior to more conventional layers in such important respects as the following:

1. Circuit fabrication time is reduced;
2. $Gd_3Ga_5O_{12}$ absorbs less in the visible spectrum, resulting in better visibility;
3. Adherence is superior; and
4. A good match of thermal expansion coefficients is provided.

In a bubble device, the Permalloy circuit is separated from the magnetic film by a thin non-magnetic spacing layer. Conventional spacing layers are not suitable for use in devices subjected to wide temperature applications, as their thermal expansion coefficients do not match the expansion coefficient of the garnet. A magnetic film sandwiched between a substrate and a spacing layer of the same composition provides a closer approach to the ideal composite structure. The depositing, by liquid phase epitaxy, of $Gd_3Ga_5O_{12}$ spacing layers on the magnetic film provides a more compatible substrate-magnetic film-spacing layer system.

The films were grown with rotation by the isothermal dipping method and were deposited on Syton-polished GGG substrates as well as on a variety of magnetic film compositions. The presence of the GGG spacing layer did not affect, significantly, the magnetic properties of the bubble domain film. Permalloy propagation circuits were fabricated on $Gd_{0.9}Er_{2.1}Fe_4Ga_{0.6}O_{12}$ magnetic film-GGG spacing layer combinations, and domains were propagated readily. The GGG spacing layers were found to be superior to conventional materials in the above-mentioned areas.

Notes:

1. The following documentation, outlining experimentation and results, may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $4.25
   (or microfiche $2.25)
   Reference: NASA CR-2413 (N74-30206), Investigation of the Growth of Garnet Films By Liquid Phase Epitaxy
2. Technical questions may be directed to:
   Technology Utilization Officer
   Langley Research Center
   Mail Stop 139-A
   Hampton, Virginia 23665
   Reference: B74-10262

(continued overleaf)

Patent status:
NASA has decided not to apply for a patent.

Source: Jerry W. Moody, Roger W. Shaw,
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03 (Physical Sciences)
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08 (Fabrication Technology)

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