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BUBBLE STRETCH PROPERTIES ON CHEVRON PATTERNS

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Stretched domain propagation margin in chevron stretcher is found to decrease for a stream of consecutive bubbles, when the pattern dimensions are reduced according to the scaling law. This tendency might be in difficulty to realize bubble devices using smaller bubbles. The purpose of this study is to develop a chevron stretcher useful for consecutive bubble propagation of 3μm or smaller bubble devices.

The specimens are composed of $(YSmTmCa)_3(FeGe)_5O_{12}$ garnet LPE films and Permalloy chevron stretcher patterns deposited on the LPE film with the spacing of 8,000Å.

Figure 1(a) shows the quasi-static stretch propagation margin for α=107° and p=17μm, where α and p are the apex angle and chevron pitch, respectively. Pitch is the sum of chevron length and gap between chevrons, the latter is 1μm in this experiment. The open and closed circles correspond to the margins for consecutive bubbles and an isolated bubble, respectively. The upper limit of the margin is defined as the bias field at which a head or a tail of the stretched domain begins to shrink from the chevron column edge. Figure 1(b) shows the static stretch margin dependence on the in-plane field phase angle θ. H_{shrink} is the bias field upper limit that the stretched domain begins to shrink from the chevron column edge. H_{ro} is the bubble strip out bias from the chevron edges. The quasi-static stretch propagation margin is, therefore, restricted by the minimum static stretch margin around θ=0° or 180°. Figure 2 shows the dependence of stretched domain propagation margin ΔH, on chevron pitch and apex angle α. ΔH for an isolated bubble is smaller for 14μm pitch pattern than for 17μm and 18μm pitch patterns. For consecutive bubbles, ΔH approaches that for an isolated bubble with increasing the chevron pitch. In these cases, the chevrons gap is kept 1μm along the column. This tendency is partly explained by the direct interactions between stretched domains. ΔH increases with decreasing α. This means that the chevron can be magnetized more easily along θ=0° or 180° on a smaller apex angle chevron.

For high frequency drive, the large H_{shrink} dependence on θ such as Fig.1(b) becomes necessary to stretch the domain at each step of the propagation, especially at the higher bias field. The H_{shrink} dependence on θ decreases with decreasing α in this experiment.

In conclusion, in order to achieve better propagation margin at chevron stretcher for smaller bubbles at higher frequencies, the followings are thought to be effective; 1)The chevron pitch should be as long as possible, unless the normal bubble propagation is interrupted. 2)The large H_{shrink} dependence on θ is necessary for high stretch rate, contrary to large quasi-static stretch propagation margin. 3)The chevron with the apex angle around 90° is better for keeping the stretched state, because it has a large quasi-static stretch propagation margin.

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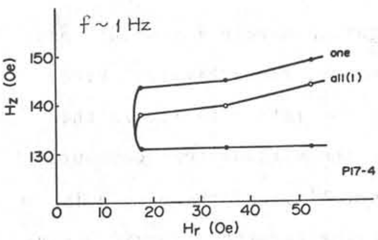

Fig.1(a). Bubble domain quasi-static stretch propagation margin on the 17μm pitch chevron stretcher.

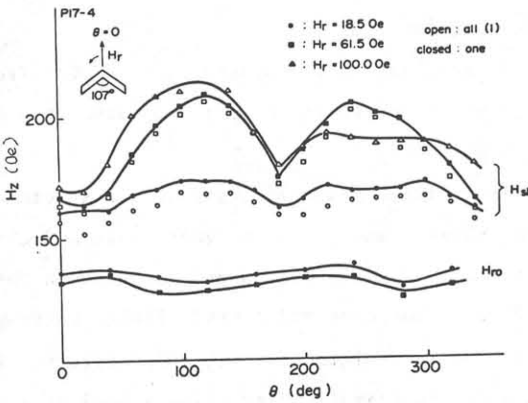

Fig.1(b). Bubble domain static stretch margin dependence on the H_r phase θ.

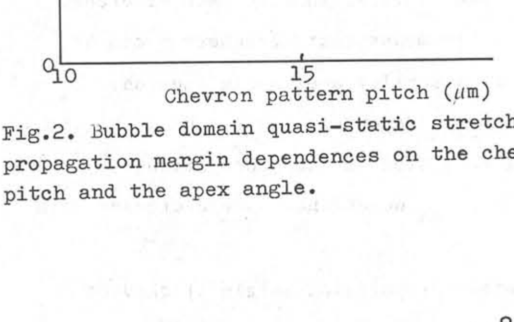

Fig.2. Bubble domain quasi-static stretch propagation margin dependences on the chevron pitch and the apex angle.