Porous Anodic Oxide Films Grown on Compound Semiconductor

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Self-ordered nanoporous anodic oxide films grown on various valve metals other than aluminum have been vigorously reported, especially in past decade. In particular, fabrication of self-ordered titanium oxide nanotubes by anodization has been received growing interest because of their exploitation in the fields of photo catalyst, die-sensitized solar cells and chemical sensors. To widen the application field of nanoporous anodic oxides, further research on the growth of anodic oxides on various metals and semiconductors is needed. Nevertheless, only few investigations were reported on porous anodic film growth on semiconductor. In these circumstances, we have studied growing behavior of nanoporous oxide as well as barrier type oxide on GaAs and InP by anodization.

The anodization behavior of GaAs was first studied in various types of acid solution. Among them, citric acid and phosphoric acid solutions were found to be adaptable to obtain an uniform and dense barrier-type anodic film, presumably composed of a mixture of Ga_2O_3 and As_2O_3 including a small amount of acid anions (Fig. 1). Anodizing ratio was found to be 1.8 nm/V. On the other hand, a thick tubular oxide layer could be obtained when sulfate was used. By optimizing the anodization condition, a well-defined self-ordered porous oxide film having cell diameter to voltage ratio of 2.6 (nm/V) was uniformly formed as shown in Fig. 2. The thickness of the film increased with increasing anodization time up to 50 μm. As shown in Fig, 3, GDOES analysis as well as AES indicated that the content ratio of Ga was lower and that of As was higher especially at the surface of porous anodic oxide layer. In the case of InP, a thick nanoporous anodic oxide film could be also obtained.

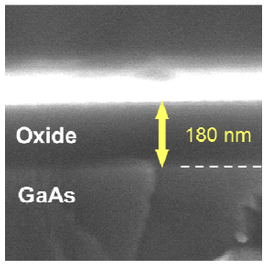

Fig. 1 Anodic oxide film formed on GaAs in phosphoric acid at 100 V.

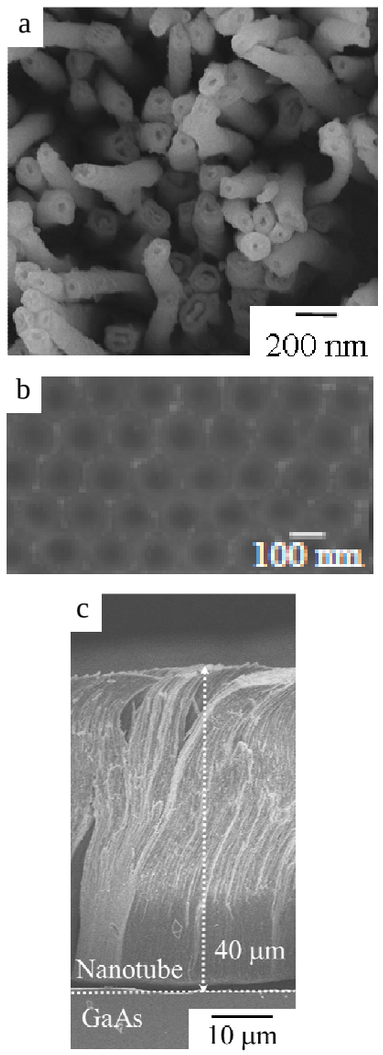

Fig. 2 Porous anodic oxide film formed on GaAs at 60 V. (a) Top view, (b) GaAs substrate after removal of oxide, (c) Cross sectional view.

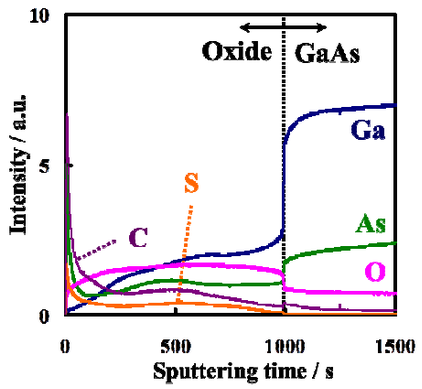

Fig. 3 GDOES depth profiles of constitute elements in porous anodic oxide film formed on GaAs at 60 V.