7C/2006G081

Manganese oxide cluster in manganese doped gallium oxynitride

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Introduction

Manganese doped gallium nitride has been attracted both theoretical and experimental interest expecting a diluted magnetic semiconductor at room temperature [1-7]. In the present investigation, the preparation of gallium oxynitride and its Mn doping were studied by nitridation of the gallium oxide precursor prepared by a citric acid route in ammonia flow [8].

Experimental

Gallium and manganese nitrates were mixed together with their equimolar amount of citric acid in distilled water. Brown precursors obtained by firing their gel were nitrided in 5 N ammonia flow in a mullite boat in the range between 750°C and 850°C for 10 h.

Results and discussion

Ga-K edge XAFS was performed on the samples nitrided at 750°C both without Mn and with 5 at% Mn. The first nearest neighbor appeared at around 0.16 nm corresponding to the Ga-(N, O) bonding distance, as shown in Figs. 1 and 2 for nitrided products without and with 5 at% Mn, respectively. Another radial distribution peak were around 0.29 nm in the product nitrided at 850°C with an improvement in its crystallinity. The appearance of the second nearest neighboring peak suggests that an improved local structure around Ga similar to that of h-GaN was achieved in the oxynitride products. Firing temperature dependence of the Fourier transform was slightly different for the Mn-doped products as compared to the above Mn-free samples. The radial distribution for Ga-Ga(Mn) in Fig. 2 was already observed at around 0.29 nm even in the case of the product nitrided at 750°C and then increased slightly in intensity at a nitridation temperature of 850°C. The manganese doping improved local structure around Ga at 750°C probably because most of the oxide ions formed manganese oxide clusters in the compound.

References

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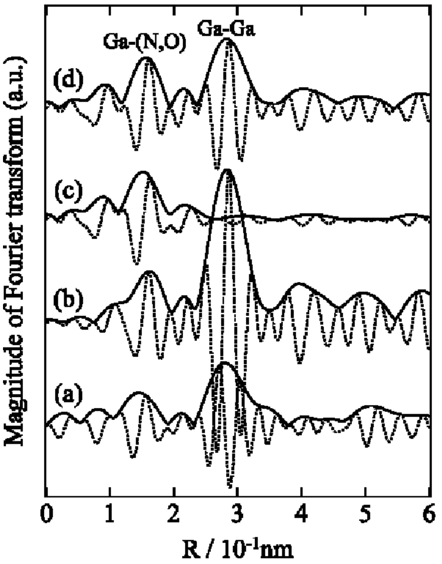

Figure 1 Fourier transform of Ga K-edge EXAFS for the samples without Mn doping. (a) Ga_2O_3 reference, (b) GaN reference, (c) the products nitrided at 750°C and (d) 850°C.

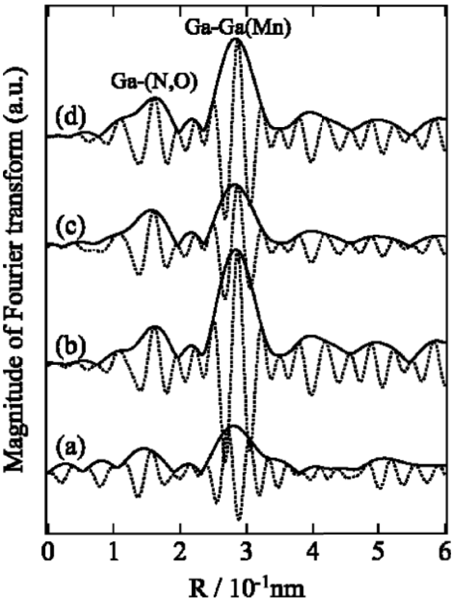

Figure 2 Fourier transform of Ga K-edge EXAFS for samples with 5 at% Mn doping. (a) Ga_2O_3 reference, (b) GaN reference, (c) the products nitrided at 750°C and (d) 850°C.