TMIn と金属 Ga のトランスメタル化による窒素中と水素中の TMGa 生成の質量分析

Time of flight mass spectroscopy analysis of transmetalation between trimethylindium and gallium in N_2 and H_2

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The gallium (Ga) contamination during AlInN growth is a well-known problem [1]. Unintentional Ga incorporation will cause lattice mismatched to GaN, lower two-dimensional electron density, and lower bandgap. The Ga supposedly originates from a transmetalation reaction between the methyl groups of trimethylindium (TMIn, $(CH_3)_3In$) to metallic Ga deposited on the showerhead. The transmetalation mobilizes the Ga by forming $Ga(CH_3)x$ which can then reach the growth surface. We have shown direct proof about the transmetalation in [2]. In this study, we found the same reaction and the same temperature dependence in H_2 ambient, but with a lower $(CH_3)_2Ga$ (DMGa) signal.

The strongest metal-organic (MO) related signals were the di-methyls, i.e. $(CH_3)_2In$ (DMIn) and DMGa, probably due to heating and ionization [3]. When TMIn is flowing, the DMGa signal gets strongest at a reactor temperature of 400°C in N_2 and 300°C in H_2. It should be emphasized again that no $(CH_3)_3Ga$ (TMGa) was introduced in the reactor. Therefore, the DMGa signals must result from transmetalation of the metallic Ga with TMIn. Even more, DMGa intensity increased when heating up to 400°C in N_2 and 300°C in H_2 and then decreasing simultaneously with DMIn. The decomposition temperature of TMGa is higher than 400°C [3]. However, TMIn is decomposing at 400°C in N_2 and 300°C in H_2, which means that no longer TMIn and DMIn arrives at the Ga boat for temperatures above TMIn decomposing temperature. The decrease of DMGa is a result of TMIn decomposition.

Acknowledgement This work was supported by MEXT “Research and development of next-generation semiconductor to realize energy-saving society” Program Grant Number JPJ005357.

References [1] M. Mrad *et al.*, J. Cryst. Growth, **507**(2019)139. [2] D. Wu *et al.,* JSAP, 13-302-9(2020). [3] Z. Ye *et al.*, Jpn. J. Appl. Phys., **59**(2020)025511.

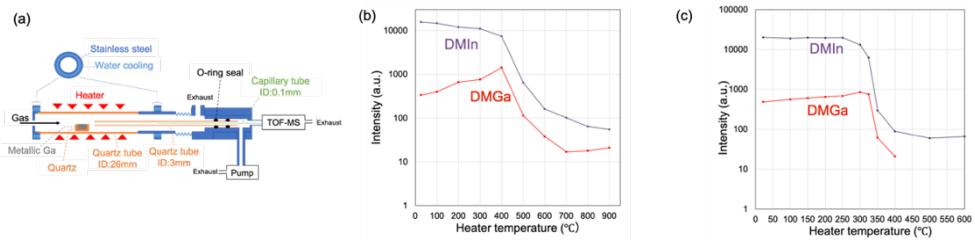

Fig.1 (a) Gas monitoring system[3] (b). DMGa and DMIn intensity change in N_2 (c) DMGa and DMIn intensity change in H_2