18p-E12-17

シクロペンタシランを用いた並列蒸着法による常圧でのa-Si:H膜の作製

Formation of *a*-Si:H films from cyclopentasilane by using parallel deposition system at atmospheric pressure

北陸先端大 [1], JST-ALCA[2], 北陸先端大 GDRC[3],
°申 仲栄 [1,2], 増田 貴史 [1,3], 高岸 秀行 [1,2], 大平 圭介 [1,2,3], 下田 達也 [1,2,3]
JAIST [1], JST-ALCA[2], JAIST GDRC[3], °Zhongrong Shen[1,2], Takashi Masuda[1,3], Hideyuki Takagishi[1,2], Keisuke Ohdaira[1,2,3], Tatsuya Shimoda[1,2,3]
E-mail: z-shen@jaist.ac.jp

The principle of fabricating devices by a liquid process has sparked intensive research from the viewpoint of reducing processing cost. Cyclopentasilane (CPS) is convenient for storage and transportation, and it is safer to handle than monosilane gas. Silicon films can be prepared easily by spin coating and post annealing. The fabrication cost is dramatically reduced because of the throughput and the simple instrument. After preparation of polysilane ink by irradiating CPS, we fabricated the silicon TFT[1] and the amorphous silicon solar cell[2] by coating methods. However the film quality is not so high because the annealing generates gas (H_2, silane, and etc) from film, leaving lots of voids inside it. Recently, we have developed a liquid-source vapor deposition (LVD)[3] to prepare *a*-Si:H film from CPS directly at atmospheric pressure. The film shows the electric property as same level as Cat-CVD sample. However, the deposition rate is quite low and microstructure factor is more than 10%.

Here we introduce new deposition system to resolve the problem on deposition rate and high microstructure factor. As shown in Figure 1, the chamber with 2 parallel substrates inside it is sandwiched by two hot plates, where two CPS supply units are set on the side wall. When the CPS evaporates into chamber and thermal decomposes on one hot substrate, it converts into *a*-Si:H and generates Si-H radical to fly toward opposite substrate. In LVD system, this radical cannot be reused and attaches on the chamber wall. In parallel deposition system, the escaped Si-H radicals deposit on the opposite substrate, dramatically increasing the raw source conversion rate to 62%. Because of the high activity of Si-H radical, it can form films even at low processing temperature and improve the film quality. That is, it provides the possibility to get a satisfied deposition rate even at low processing temperature. However this system cannot apply for silane gas because the SiH_4 needs much higher temperature to decompose, and no additional Si-H radicals generate from opposite substrate.

In conclusion, parallel deposition system maintains the advantage of LPCVD and PECVD or Cat-CVD when using CPS as silicon source. We obtained a one-order of magnitude higher deposition rate than LVD. The film shows a photo conductivity of 1.74×10^{-5} S/cm with a microstructure factor of 0%.

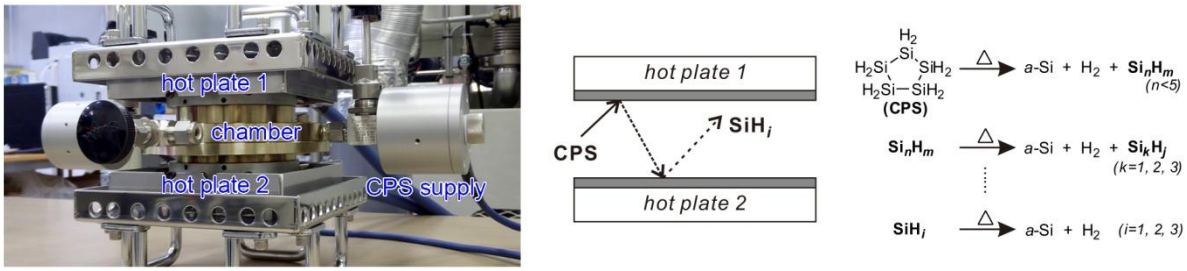

Figure 1. (*left*) the image of parallel deposition system. It include one chamber, two hot plates and two CPS supply units; (*right*) the possible mechanism for CPS decomposition between two hot plates, where CPS thermally decompose into a-Si:H and generates Si_nH_m radical for the deposition on the opposite substrate.

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