

## 1970s

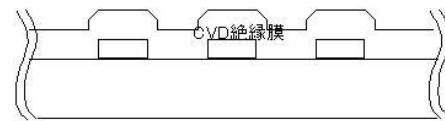
### Usage of reflow in a flattening technique

#### ~ Process Technology ~

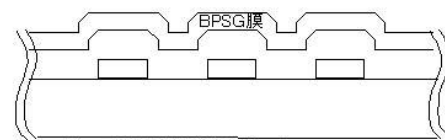
In the silicon gate process, the insulating film between the gate and the Al interconnect of the upper layer form sharp steps at the pattern edges of the lower layer polysilicon. In this situation, the coverage of Al becomes poor at the steps and easily disconnected, and the technique to smooth out the steps becomes necessary. In the early technology, a reflow technology, in which a PSG film, an oxide film doped with high concentration phosphorus, was heated at a high temperature of about 1000°C to smooth the surface and to alleviate the step difference.

In this method, ①high temperature heating is required, which in turn enhances the diffusion of the diffusion layer, thereby hindering miniaturization. In addition, ②there was a concern such as deterioration of the reliability of Al corrosion by sucking moisture in the atmosphere, if phosphorus concentration is made high in order to improve the reflow property. Later, BPSG (oxide film doped with phosphorus and boron) for lower temperature reflow (1000°C or lower) was used.

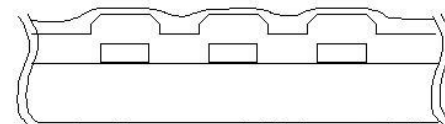
These films also have the property of gettering (immobilizing the movable ions) of ions such as Na, and the two-fold merits were obtained of reliability improvement and surface planarization. Initially, atmospheric pressure CVD was used, but low-pressure CVD came to be used from the viewpoint of film thickness uniformity and film quality.



(1) CVD insulator deposition



(2) BPSG film deposition



(3) Reflow of BPSG at high temperature

Fig. Reflow Flattening Process by BPSG

#### Reference:

- 1) S. M. Sze 「VLSI Technology」1983