

Report

Date 5-May-2016

DENSO Driving Assist & Safety Eng. Div.3
Driving Assist & Safety Quality Assurance Div.

To HONDA NORTH AMERICA, INC.
Market Quality Department.

cc _____

Title Filed claim investigation result for Airbag sensor (G2)

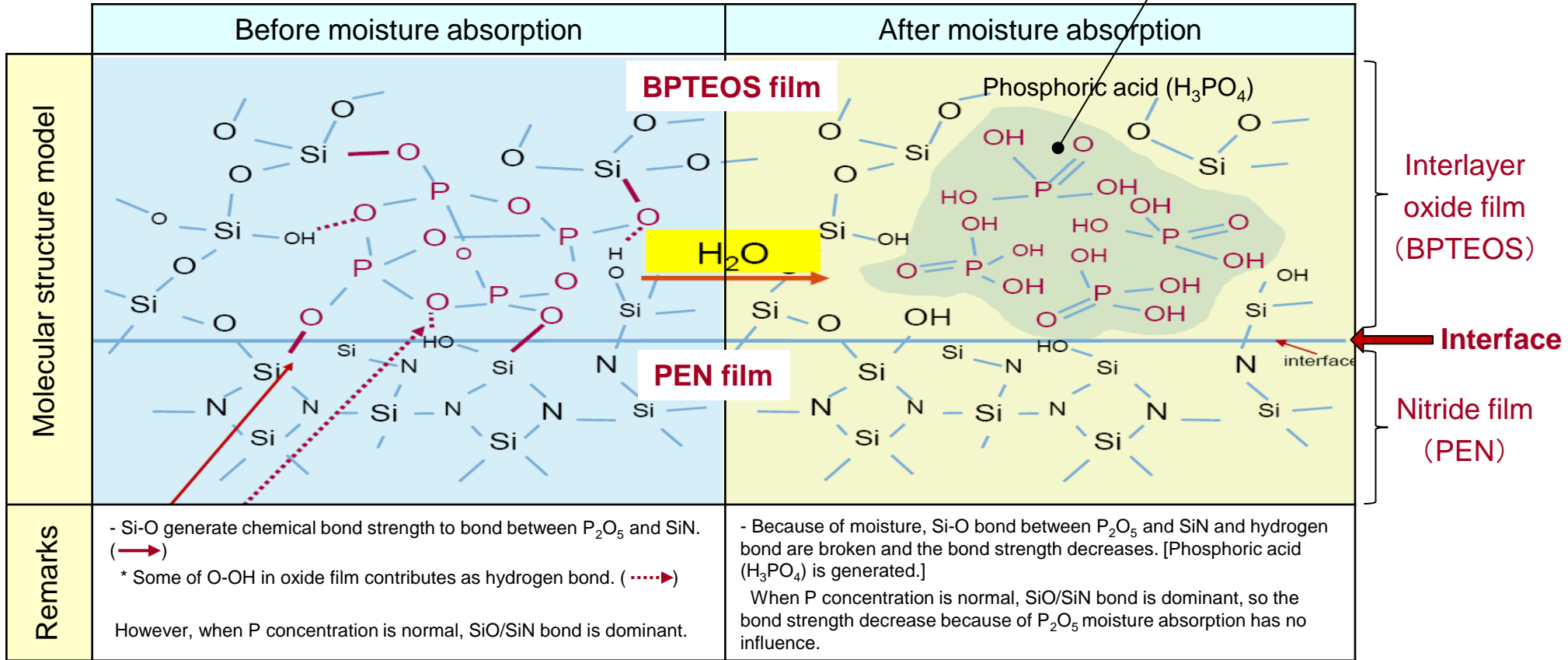
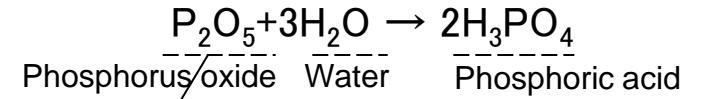
We report the field claim investigation result for Airbag sensor.

Part Name : SENSOR ASSY, SATELLITE SAFING (rep)
Part Number : 77975T6A J110M2 (rep)

Interlayer film delamination process

Process	Interlayer film condition	Description
Initial		<p>Interlayer oxide film contains P(Phosphorus) and B(Boron).</p> <ul style="list-style-type: none"> ...P and B protect the impurity ion in order to acquire the transistor characteristics.
Absorb moisture ↓ Delamination occurs		<p>When P concentration between BPTEOS and PEN increased, the interfacial bond strength decreased, and interlayer film was delaminated.</p> <p>➔ Mechanism of bond strength decrease on the next page.</p>
Via disconnection occurs		<p>Via was disconnected because of tensile stress.</p> <p>(Delamination/disconnection occurred at chip edge with large internal stress.)</p>

Mechanism of bond strength decrease



- in case of **normal P concentration** ⇒ P area is **small** ⇒ bond strength > Tensile stress ⇒ No delamination
- in case of **rich P concentration** ⇒ P area is **wide** ⇒ bond strength < Tensile stress ⇒ **Delamination**

P concentration affects the interfacial bond strength.

5. Cause and countermeasure

BPTEOS deposition device overview

* Machine below: FF09 (A, B, C, D) and FF10 (A, B, C, D)

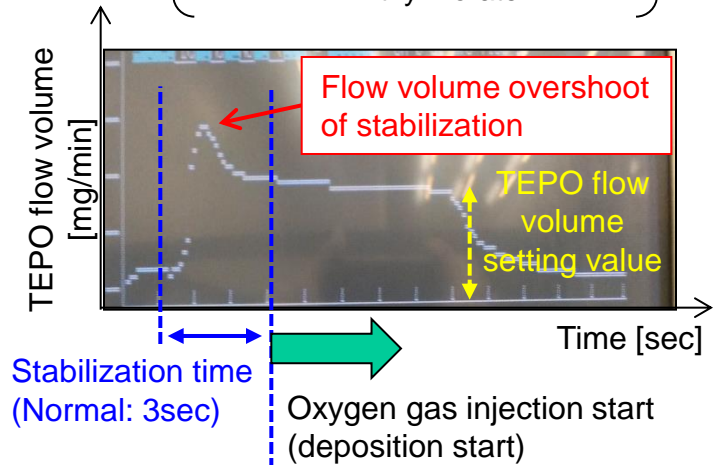
② Oxygen gas

① Carrier gas

LFM * Liquid Flow Meter

Gas injection setting profile

* TEPO: Tri Ethyl Phosphate
TEOS: Tetra Ethyl Ortho Silicon
TEB : Tri Ethyl Borate

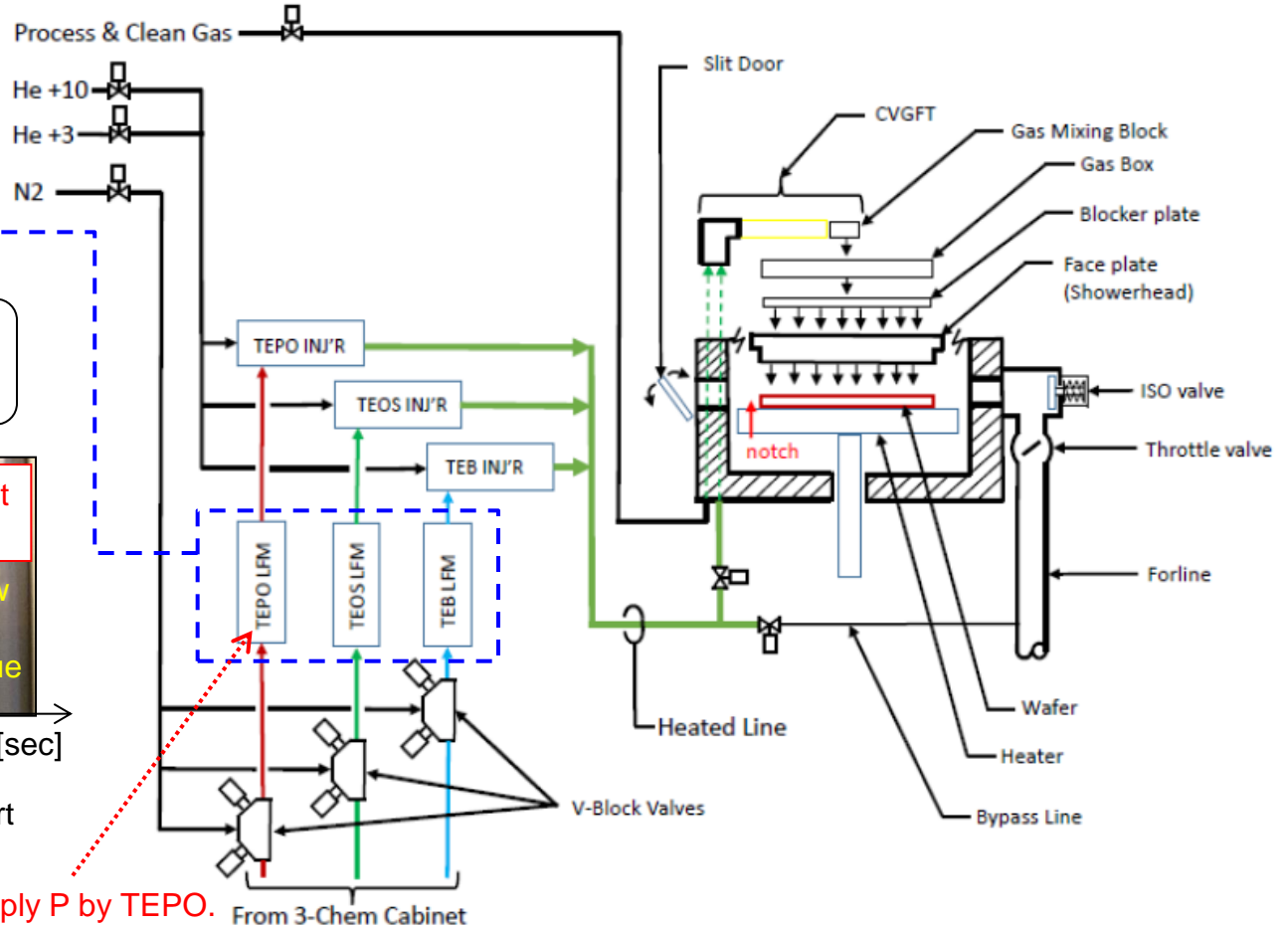


①

②

Supply P by TEPO.

From 3-Chem Cabinet



Confirmed that the process change of TEPO flow setting was happened. → Next page

Cause and countermeasure

<Occurrence cause: Flow volume profile change>

Cause	Countermeasure (1)
<p>- Machine error occurred because of TEPO flow volume variation. Maintenance engineer changed the flow volume profile in order to control the variation. (Changed to an overshoot waveform to make the flow volume stable early.) * At this moment, no knowledge that overshoot causes local concentration increase. ➔ At the time of deposition start, P concentration in chamber (shaded area below) increased, and P concentration of interface between BPTEOS and PEN films (soon after deposition start) increased.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><Before change></p> </div> <div style="text-align: center;"> <p><After change></p> </div> </div>	<p>- Changed the flow volume profile not to overshoot. ('14/12/17~)</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><Before countermeasure></p> </div> <div style="text-align: center;"> <p><After countermeasure></p> </div> </div>

Changed the flow volume profile to limit the peak of P concentration of interface between BPTEOS and PEN films.

Countermeasure (2)

Perform 100% monitoring of peak ratio for TEPO flow volume setting value in flow volume profile. (Sept. 1, 2015 ~)

Control item: TEPO flow volume setting value x Peak ratio

Control interval: 100% monitoring

Control value: 1.2 or less

* In the case of over 1.2 --- Machine stops. (Scrap the product.)

After adjusting the machine, check with SIMS result, and then flow.

<TEPO flow volume setting value x Peak ratio >

Actual measured value
(Peak)

TEPO flow volume
setting value

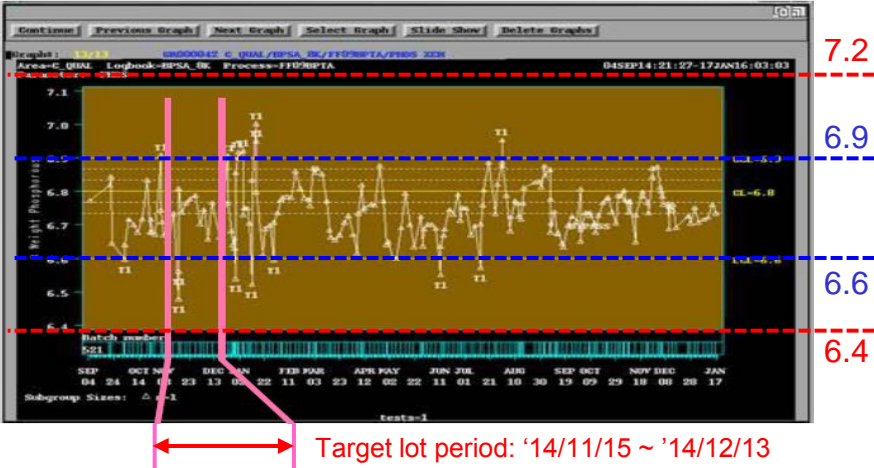
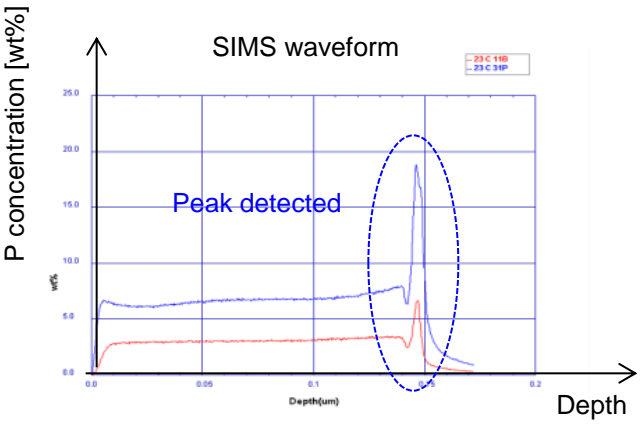


* The above is the waveform of ratio ≈ 1.5 . (Created intentionally.)

Perform 100% monitoring to see that flow volume profile is not overshoot.

<Flout cause: Phosphorus concentration control by X-ray fluorescence>

* SIMS --- Secondary Ion Mass Spectroscopy

Cause	Countermeasure
<p>- P concentration has been controlled by X-ray fluorescence. In this method, only average value of P concentration in deposition direction can be obtained, and local P concentration increase cannot be detected.</p> <p>* No knowledge that increase of local P concentration causes delamination.</p> <p>Process control width: 6.6 ~ 6.9wt% (Product spec: 6.4 ~ 7.2wt%)</p> <p><X-ray fluorescence P concentration near target lot></p>  <p>→ During the target lot period, P concentration (average value) increase was not detected.</p> <p>* Correlation between P concentration (average) by X-ray fluorescence and P concentration (local) by SIMS is weak.</p>	<p>- Introduce SIMS to control local P concentration. ('14/12/17~) (Continue concentration control by X-ray fluorescence.)</p> <p>Control item: P concentration peak Control value: MAX 9.2% Control interval: 2/week or after every maintenance * Chamber A: 1/D (under special control)</p> <p>Measuring position: Center of wafer (Set as a result of investigation of distribution in wafer surface)</p> 

Introduced SIMS control for workmanship control of P concentration peak value.