Abstract

In anti-reflective coating, locational tolerance is very important. Working with Raytheon, we developed and explored a novel fixture mechanism to secure sensor microchips quickly, accurately, and efficiently without damaging them. Multiple designs were developed and rapid prototyped after extensive research and analysis. From these prototypes, we developed our final product, the Chip Fixture Assembly for Anti-Reflective Coating. Table 1 lists our test results.

Tolerance Stack-Up

Design specifications require the assembly to secure IR chips within 0.001" accuracy. The assembly was designed so the tolerance stack up is only dependent on two critical pieces, the aperture and the alignment sheet. The two pieces use a pin and a slot as a common datum.

Cap Tolerance:
$$T_{cap} = T_{pin} + T_{hole1} + T_1 + T_{edge1}$$

Shim Tolerance:
$$T_{shim} = T_{pin} + T_{hole2} + T_2 + T_{edge2}$$

Total Tolerance

$$T_{total} = T_{cap} + T_{shim}$$

$$= 2T_{pin} + T_{hole1} + T_1 + T_{edge1} + T_{hole2} + T_2 + T_{edge2}$$

$$= 2.43 \times 10^{-3} \text{ in}$$

Purpose and Background

Raytheon Vision Systems (RVS) designs and manufactures chips for infrared sensing applications. An anti-reflective (AR) coating is applied, via vapor deposition, onto the surface of these chips to filter out undesired wavelengths to produce a clearer image. The fixture for these chips is currently complex and slow to assemble. Our fixture presents a novel method capable of precise alignment and accommodating various chips and sizes while reducing the assembly time.

Conclusion

Our novel fixture mechanism was able to quickly secure 4 silicon microchips without scratching them in 7.5 minutes. Our XY Tolerance results were inconclusive because our test methods were constrained by available equipment. Since the specific fixture mechanism was acknowledged by Raytheon to be innovative, they are looking to pursue an intellectual property disclosure.

Testing and Results

The requirements our design needed to meet, and the results of testing our final design, are shown in Table 1.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Goal</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum Compatible</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Cycle Time &lt; 20 minutes</td>
<td></td>
<td>7.5 minutes</td>
</tr>
<tr>
<td>Number of Secured Chips</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Fix Chips Securely</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Cannot Damage Chips</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>XY Tolerance for Anti-Reflective Coating</td>
<td>0.001”</td>
<td>0.011” *</td>
</tr>
</tbody>
</table>

Table 1. Requirements and result of final design.

* Tolerance results inconclusive due to available test methods

Acknowledgments

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Stephen Chen

References