

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

THE BOEING COMPANY
Petitioner,

v.

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
Patent Owner.

SUPPLEMENTAL DECLARATION OF JUNLAN WANG, PH.D.

I, Dr. Junlan Wang, declare as follows:

1. Figure 3.15(c) of Wang-Dissertation shows a stress wave in fused silica that is modified to have a long linear ramp of ~ 26 ns in length and a sharp decompression shock (or pressure drop from 0.6 GPa to 0 GPa) of a few nanoseconds. Ex-1003, Fig 3.15(c).
2. The existence of a tensile peak following this decompression shock is immaterial to whether a decompression shock occurred.
3. Figure 3.14(c) of Wang-Dissertation shows an unmodified wave profile in silicon that has a rise time around 3 nanoseconds and long post-peak decay of approximately 12 nanoseconds. Ex-1003, Fig. 3.14(c).
4. The experimental signals measured in Wang-Dissertation were measured on the free surface of the test film. Therefore, the existence of experimental signals indicates that the stress wave reached the free surface.
5. The compression wave that propagates to the constraining layer free surface (what PO refers to as “compression-wave-2) and reflected from the free surface of the constraining layer (what PO refers to as “tension-wave-1) would not reach the test film before the compression wave that propagates to the test film (what PO refers to as “compression-wave-1). This is because based on the film thickness in Wang-dissertation and the wave speed in aluminum film, the time it takes for the

compressive peak to be reflected into a tensile stress and travel back to the interface can be calculated by the following equation:

$$\frac{2h}{c} = \frac{2 * 1\mu m}{6400 \frac{m}{s}} = 0.3 \text{ ns}$$

Therefore, it only takes 0.3 ns for the reflected tensile peak from compression-wave-1 to reach the interface. Within this time frame, the peak stress from tension-wave-1 has not reached the interface yet (since the tensile peak from “tension-wave-1” is about 2 ns behind the peak of “compression-wave-1”).

6. A POSITA would understand that any wave will attenuate to some extent in any substrate and how to counter these effects of attenuation by modifying various experimental parameters. *See, e.g.,* Ex-1005, 46-80. For example, the power pulse of the laser could be increased to counter the effects of attenuation. As another example, a thinner substrate can be used to counter the effects of attenuation. As yet another example, a thicker confining layer can be used to counter the effects of attenuation.

7. Both quartz, a type of silica glass, and fused silica have a chemical composition of SiO₂.

8. Each of Pyrex, Soda lime, borosilicate, and fused silica have a non-crystalline arrangement.

9. Fused silica propagates and modifies a stress wave in a manner similar to quartz, Pyrex, Soda lime, and borosilicate.

10. As stated in my previous declaration, my dissertation describes my tensile laser spallation techniques for measuring thin-film adhesion, and is in the same field of invention as identified in the '684 Patent and Dr. Gupta's prior work (Gupta-1992 and Gupta-1993) and focused on the same objective to measure the tensile strength of interfaces between substrates and thin films. A POSITA would have had combine Gupta-1992's and Gupta-1993's teachings when implementing a tensile laser spallation technique for thin films and using fused silica to increase interfacial stress for thin films as taught by my dissertation. My dissertation cited Gupta-1992 and its tensile laser spallation techniques. Ex-1005, 4. Given the few academics in the niche field of laser spallation techniques for measuring thin-films in the 1990s and early 2000s, a POSITA looking to develop tensile laser spallation techniques for thin films at the time of the invention would know to look to the research of key players such as Dr. Gupta and myself.

11. In addition to Wang-Dissertation (Ex-1003), my 2009 paper entitled "High strain-rate spallation and fracture of tungsten by laser-induced stress waves" (Ex-1056) shows that fused silica modifies the stress wave.

12. For example, Figure 3 (below) shows the substrate stress profile of a non-modified, or Gaussian, wave:

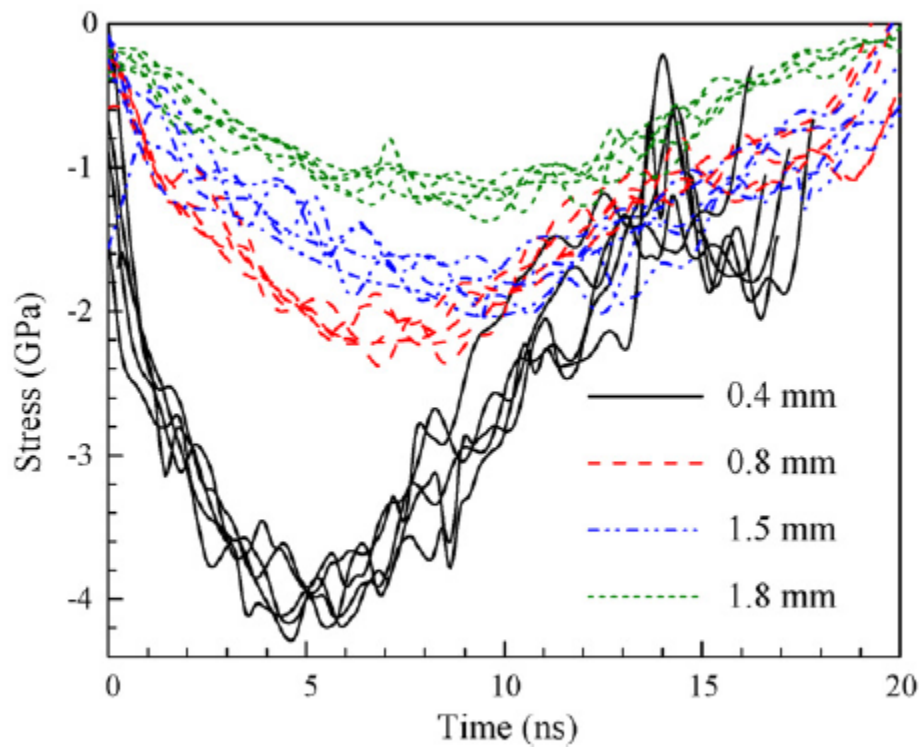


Fig. 3. Substrate stress profiles in W substrates with different thicknesses: 0.4, 0.8, 1.5 and 1.8 mm due to Gaussian wave loading.

13. In contrast, Figure 5 shows the stress profile of a stress wave that was modified by a fused silica layer:

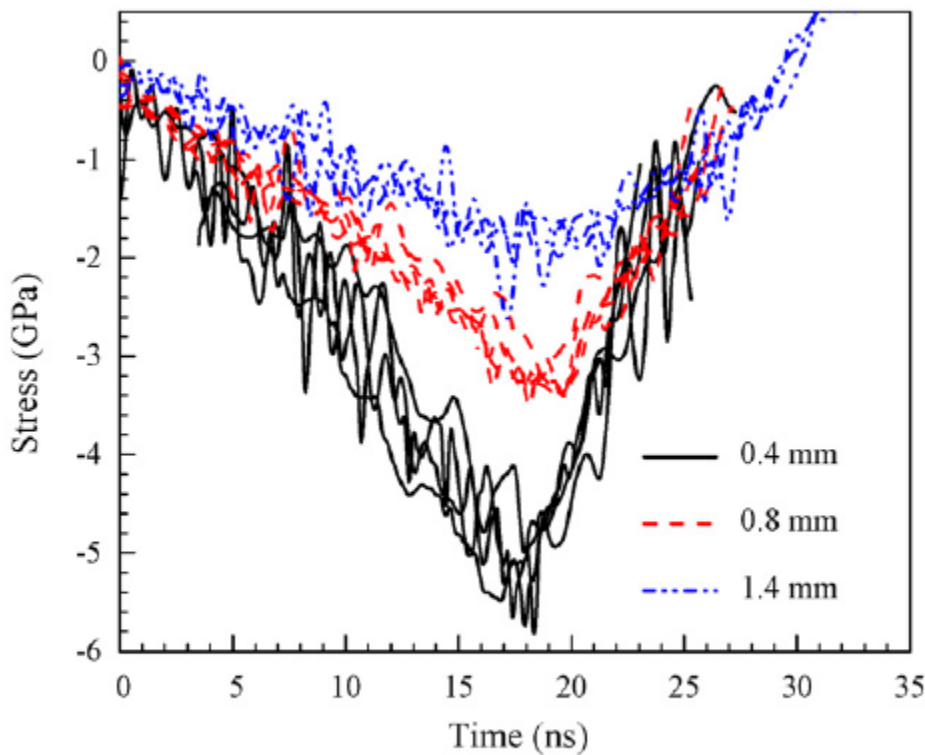


Fig. 5. Substrate stress profiles obtained on W substrate of different thicknesses: 0.4, 0.8 and 1.4 mm due to shock wave loading.

14. The unmodified wave has a Gaussian loading with rise time less than 5 ns followed by a long unloading of 10-15 ns while the modified stress wave has a linear ramp load stretched to ~18 to 20 ns and shorter unloading portion of ~10 ns.

15. This Declaration represents the opinions that I have formed up to date based on the material currently available to me. I reserve the right to revise, supplement, and/or amend my opinions stated in this Declaration based on new information that becomes available to me and on my continuing analysis of the materials available to me.

16. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: April 24, 2025



Dr. Junlan Wang