Production of sub-micron adhesion layers for high power laser microtargets

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INTRODUCTION

Adhesion layers used in the assembly of multilayer thin film targets can drastically compromise the results as it adds an additional and unintended layer to the target design. Ideally, no adhesive should be used but this can be impractical in many cases and so the adhesive layer, when used, should be as thin as possible.

This poster describes the manufacture of a single-crystal diamond target with a 5 micron copper foil adhesive-bonded to the rear surface. Following a series of tests, an application technique was developed allowing an adhesive film of only 1 micron to be used.

The completed targets were part of an academic access experimental run on the Orion laser at AWE.

THE TARGET

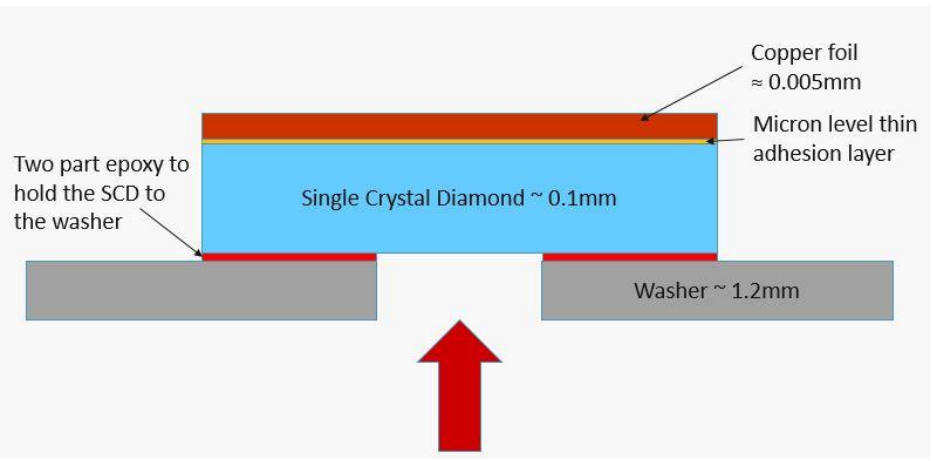


Figure 1: A schematic of the target used on the Orion laser for an academic access experiment

TARGET MANUFACTURE

- Polymethylmethalcrylate (PMMA) was chosen to be used as the adhesion layer. Spin coating was used in the coating phase with initial work being carried on microscope slides followed by the single crystal diamond (SCD).
- Thickness characterisation was done using a Tencor Alpha step profilometer.
- Final spin coater settings for the SCD were as follow,
  - Spin speed = 3600RPM
  - Spin time = 26 seconds
  - Acceleration = 800 RPM/s

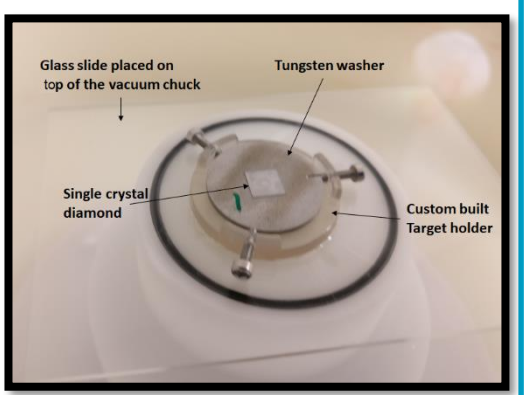


Figure 2: Target manufacture setup .

RESULTS

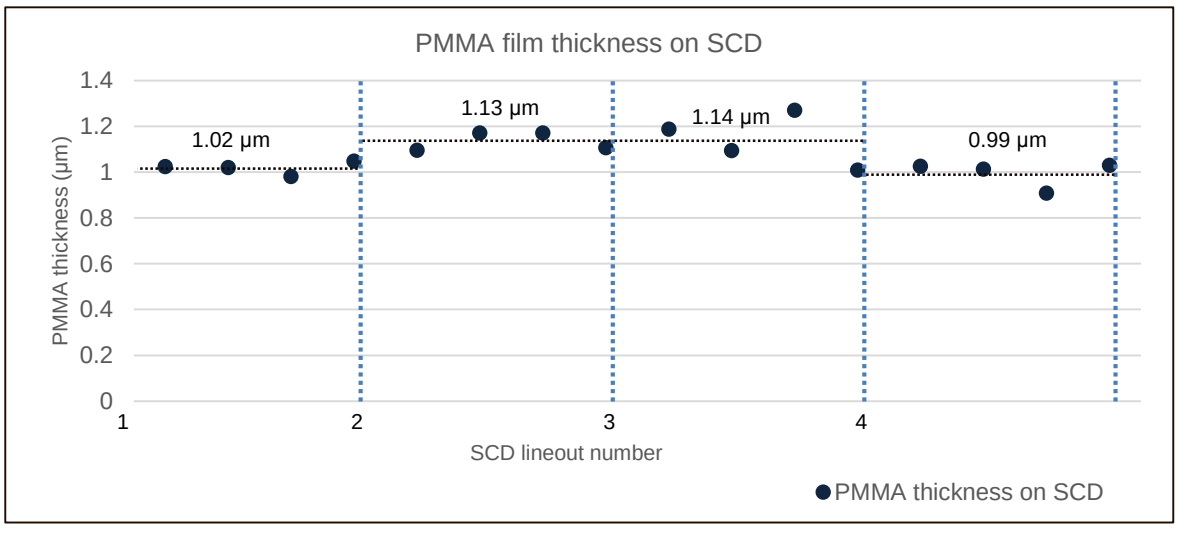
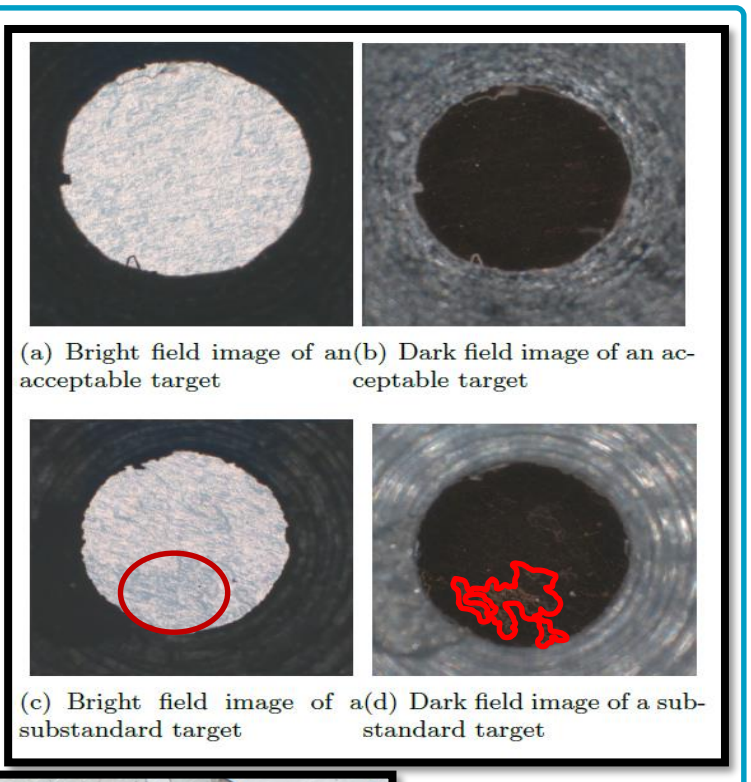


Figure 3: Average thickness of 1.07+/- 0.38um. The thickness was prior to the Cu foil being placed



(a) Bright field image of an acceptable target

(b) Dark field image of an acceptable target

(c) Bright field image of a substandard target

(d) Dark field image of a substandard target

Figure 4: Above shows some of the completed targets. Fig 2a and 2b shows an acceptable target and fig 2c and 2d one shows a substandard target.

OUTCOME AND FUTURE WORK

- Achieved an average thickness of 1.07um +/- 0.38um.
- 7/15 targets seemed to have uneven PMMA layers
- Reasons
  - Applied force in the drying process isn't enough
  - Foil movement after placed the SCD
  - The roughness in the copper foil leaving air pockets?
- Further study in to the parameters of the spin coater.
- Study the acceleration of the spin coater especially
- Adhesive concentration
- Measure the thickness of an assembled target to confirm the thickness

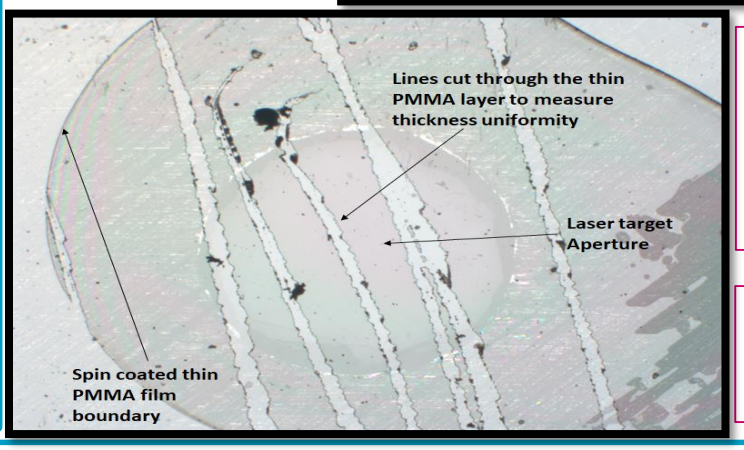


Figure 5: On the left shows the laser interaction area where small incisions are done to measure thickness