Adhesion Lithography Peel Tool Design

Introduction

This document describes the design specifications for the adhesion lithography peel tool created under through an Adventurous Manufacturing grant from the EPSRC. This tool is designed to automate the peel step of the adhesion lithography process and can be used to create nanogaps between different electrodes.

It is designed to be used with a variety of substrates including glass Si wafers and plastic and is compatible with different thickness and substrates up to 200 x 200cm in size.

Peel Tool

The peel tool consists of:

- 2 rollers (1 tape mount roller and one collector roller)
- A stepper motor with gears attached the collector roller
- Arduino controller, power supply and laptop to control stepper motor movement
- An adjustable Teflon tape mount
- A tape press with micrometre control
- A porous ceramic vacuum plate
- A base and frame to hold these components. This frame should be adjustable in terms of height and position, so the parameters can be optimised for different material and process parameters

The schematic in figure 1 for illustrative purposes only and described the setup and components need to fabricate this peel tool.

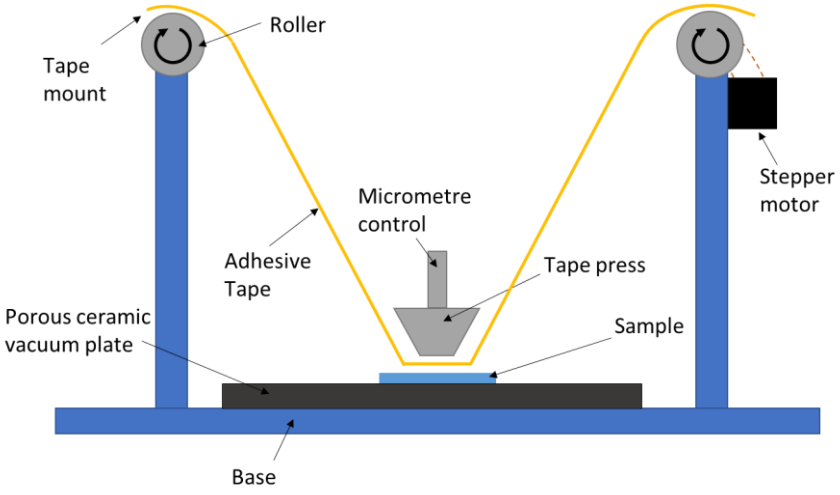

Figure 1: Schematic for Adhesion Lithography peel tool

The image in figure 2 shows the prototype tool fabricated and located at the University of Cambridge.

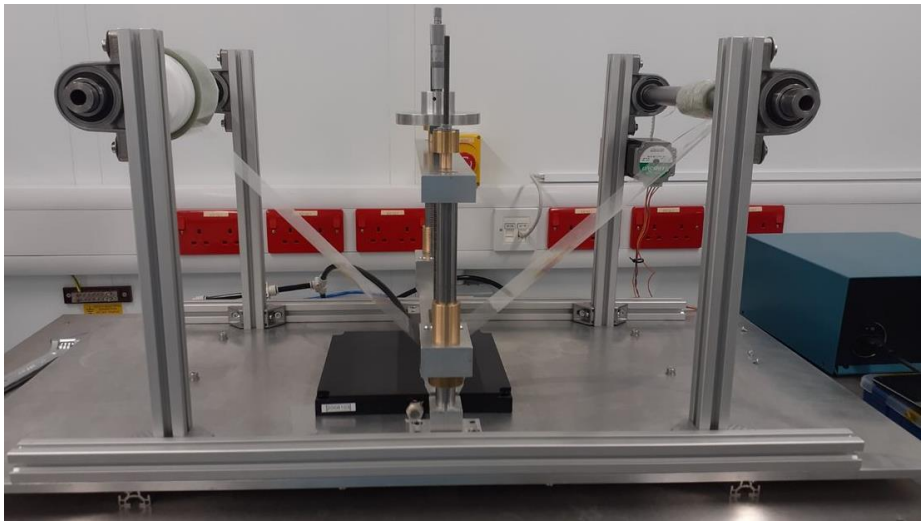

Figure 2: Photography of prototype peel system located at the University of Cambridge

Constituent Parts

This section described the constituent parts the adhesion lithography peel tool

Rollers and motor

Both rollers are free moving via ball bearing attachments. The are both mounted onto off the shelf aluminium brackets and bolts (figure 3(a)). The tape mount roller has a custom made Teflon tape holder which is designed to hold different sizes of tape spools and is held onto the roller with bolts (figure 3(b)). The tape collector rolled attaches to the tape simply using the adhesive nature of the tape (figure 4 (a)). It is connected to a stepper motor through via a rubber belt (figure 4 (b). The stepper motor is also attached to the system on the aluminium on bracket

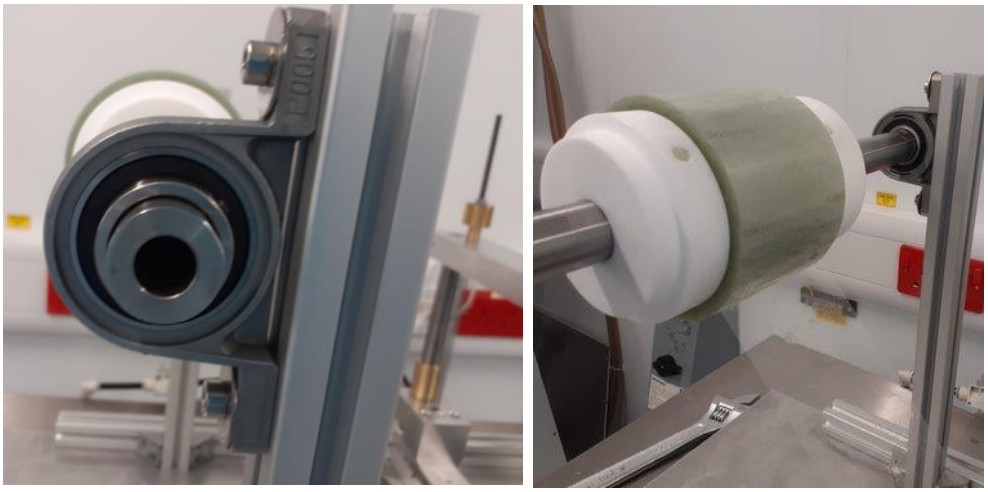

Figure 3: Roller 1 and Tape Mount

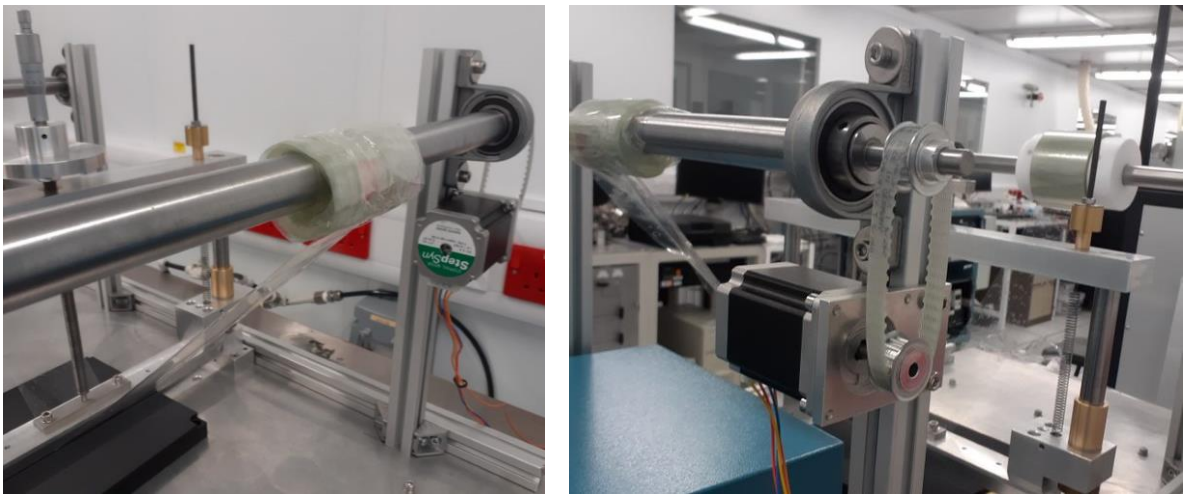

Figure 4: Roller 2 and stepper motor

Motor Control

The stepper motor is powered through an Arduino board with a 24 V power supply (figure 5). In the prototype system an Ardunio Mega board with an ARD RAMPS KIT 1.4 is used. The system is then attached to a PC and Ardunio software is used to control the speed and jerk of the motor.

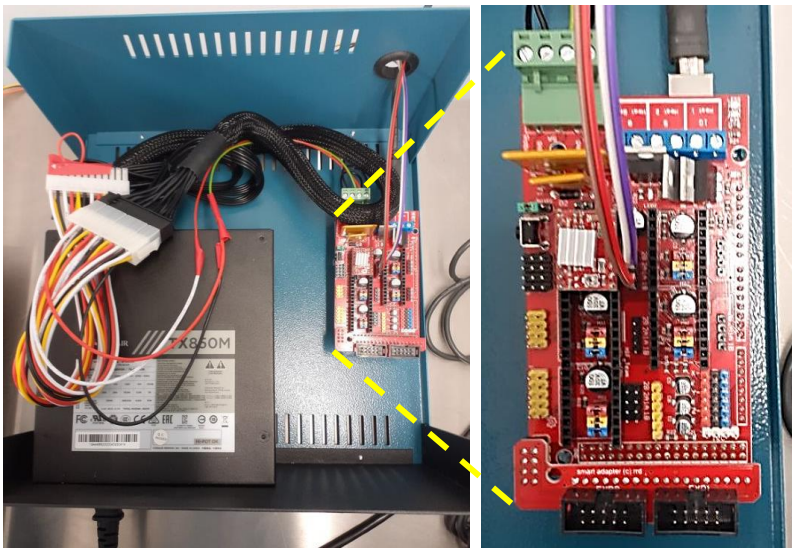

Figure 5: Power supply and Arduino controller for stepper motor

Tape press

A tape press made of aluminium is used to move the tape into contact with samples. The tape press has fine and coarse control through a coarse screw and a micrometre screw (figure 6).

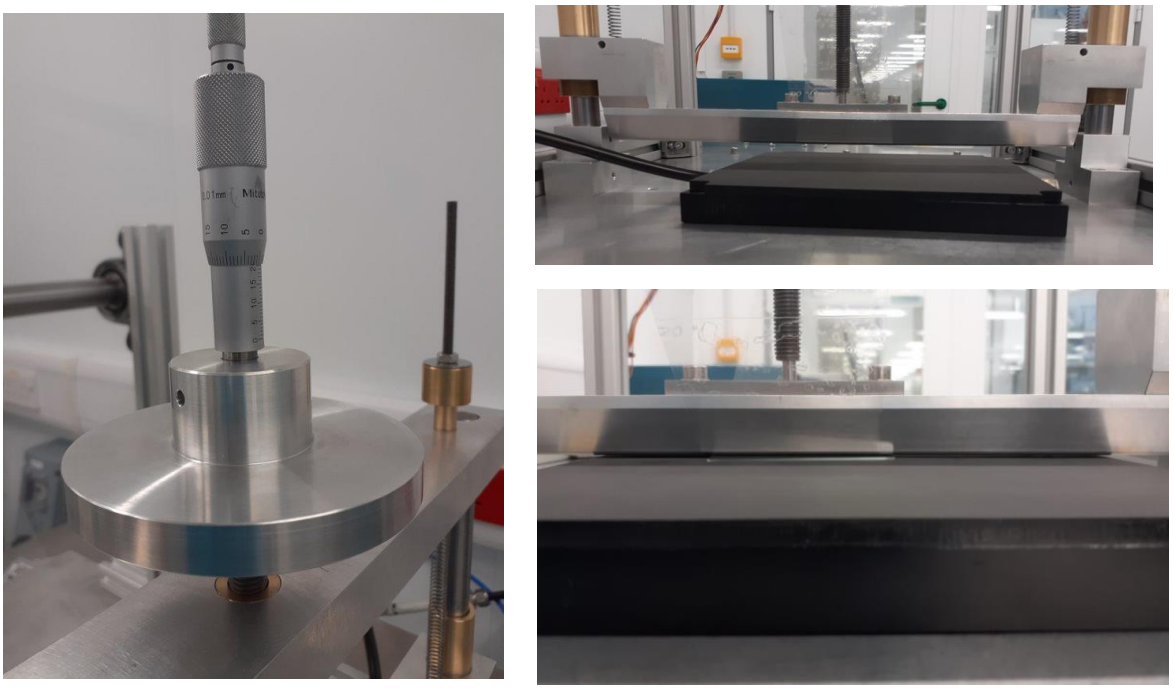

Figure 6: Micrometre control on tape press and images of press

Vacuum Plate (substrate holder)

The porous vacuum plate the pore size is small enough to allow for vacuum hold of different sized samples. The vacuum is controlled using compressed air a control valve with an ejector attached. This weak vacuum causes the sample to be fixed to plate but allows for lateral movement. It can be controlled so the sample can be held by the vacuum but be moved along by the tape movement and facilitate successfully peeling The plate can also be operated at positive pressure to facilitate float operation. This can also be used in peel operation depending on substrate and adhesive needed.

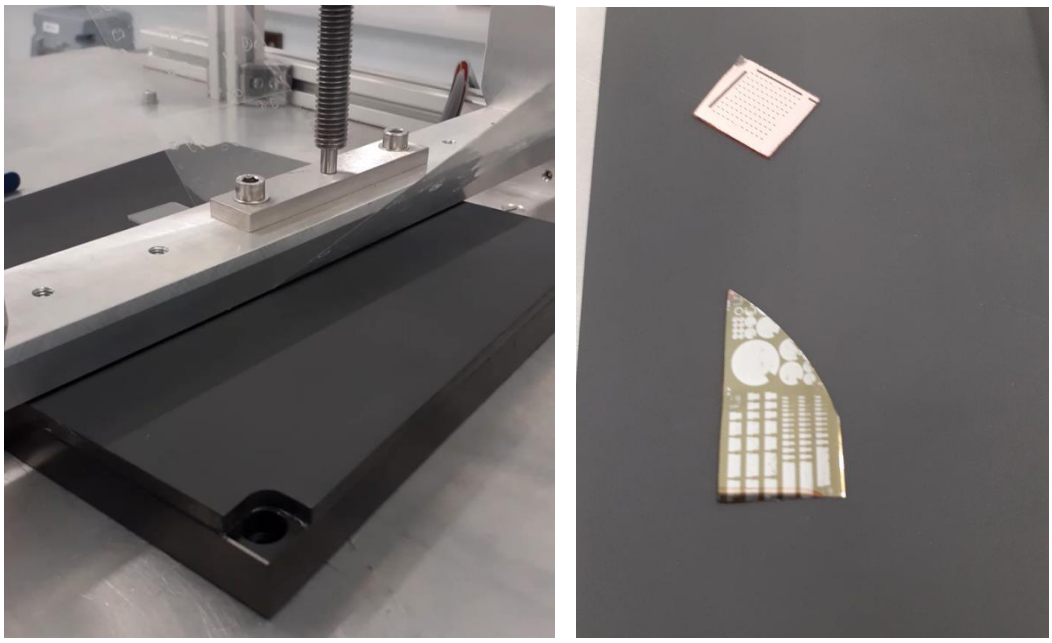

Figure 7: Porous ceramic vacuum plate

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Frame

The frame is made using standard aluminium struts for maximum manoeuvrability of the components. This is to optimise of different peeling conditions (e.g. allow for variations in adhesive tape, press and angle of tape and substrate type and size).