

Democratizing van der Waals materials with LEDs and 3D Printers

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Abstract

Van der Waals materials are crystals that can be split into layers at the atomic level and essential to many emerging products on the market. The goal of this research was to adapt a standard optical microscope to allow study and manipulation of van der Waals materials. To achieve the former an LED circuit was built into the microscope. For the latter, a 3D printer and standard mill were used to construct a sample holder, a platform, and a spacer. These components, along with other off-the-shelf products, made an ensemble that can move, and stack van der Waals flakes. The methods, design, and capabilities are discussed.

LED illumination

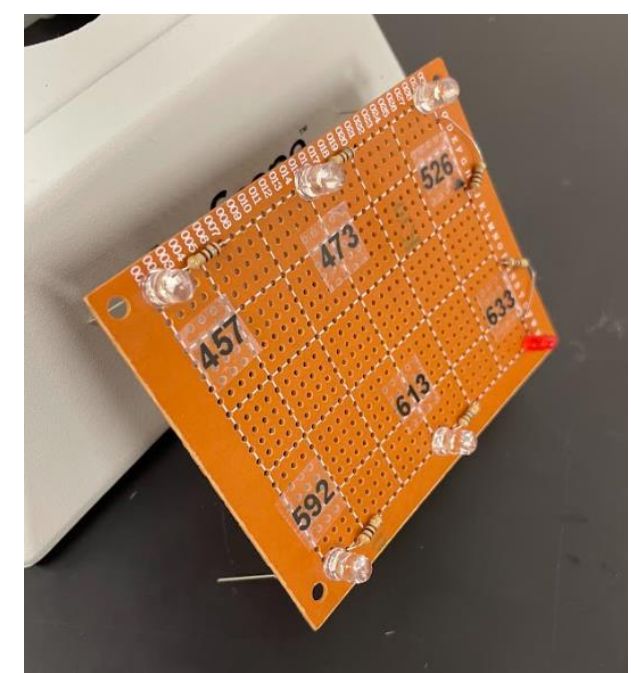


Figure 1: LED board to illuminate flakes with six different wavelengths and example image of graphene under white and 526 nm light

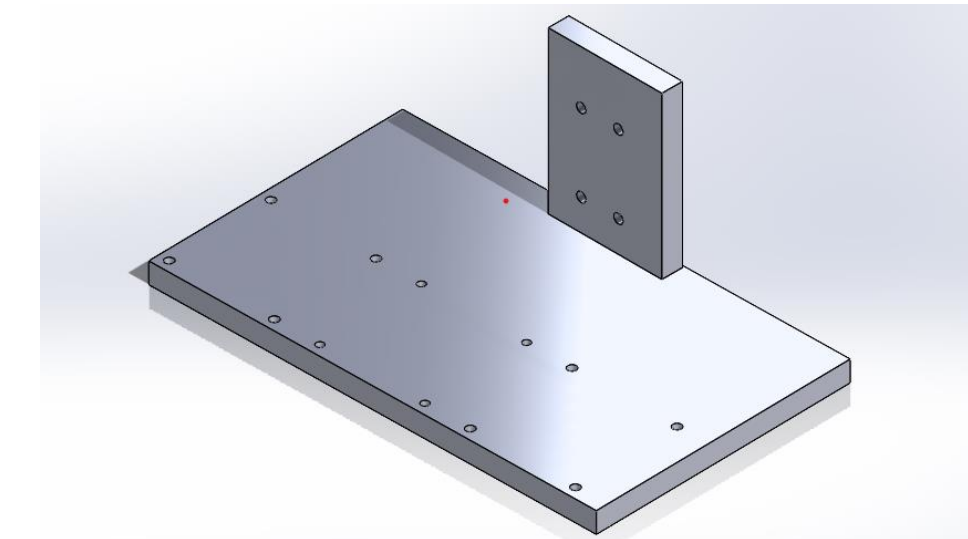
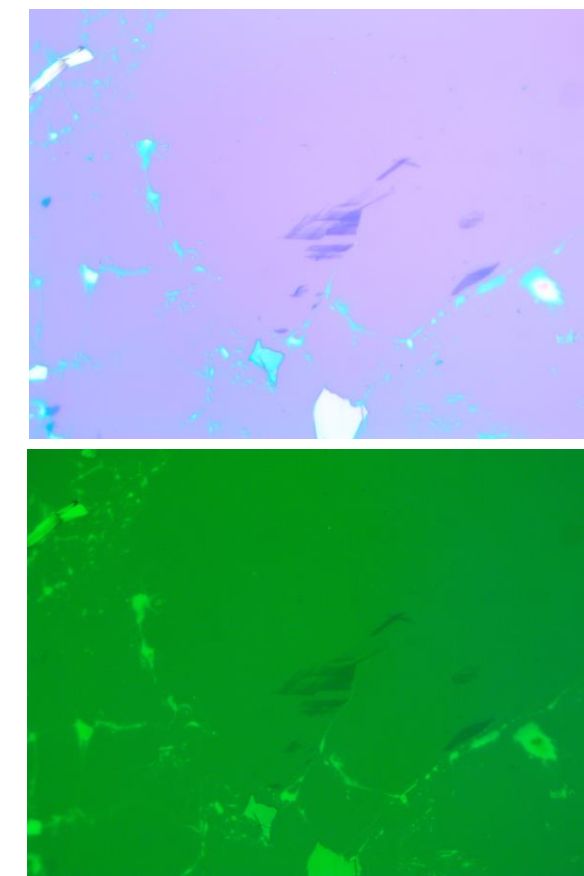


Figure 2: CAD rendering of platform

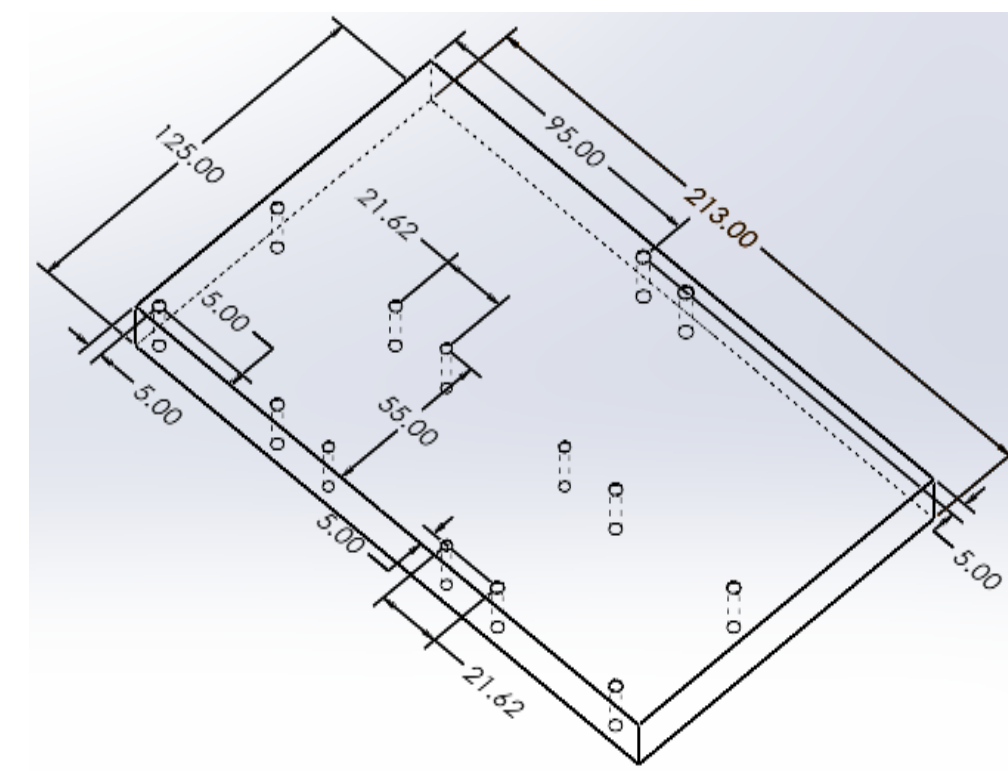


Figure 3: CAD diagram of platform base (units mm)

Design of the Platform

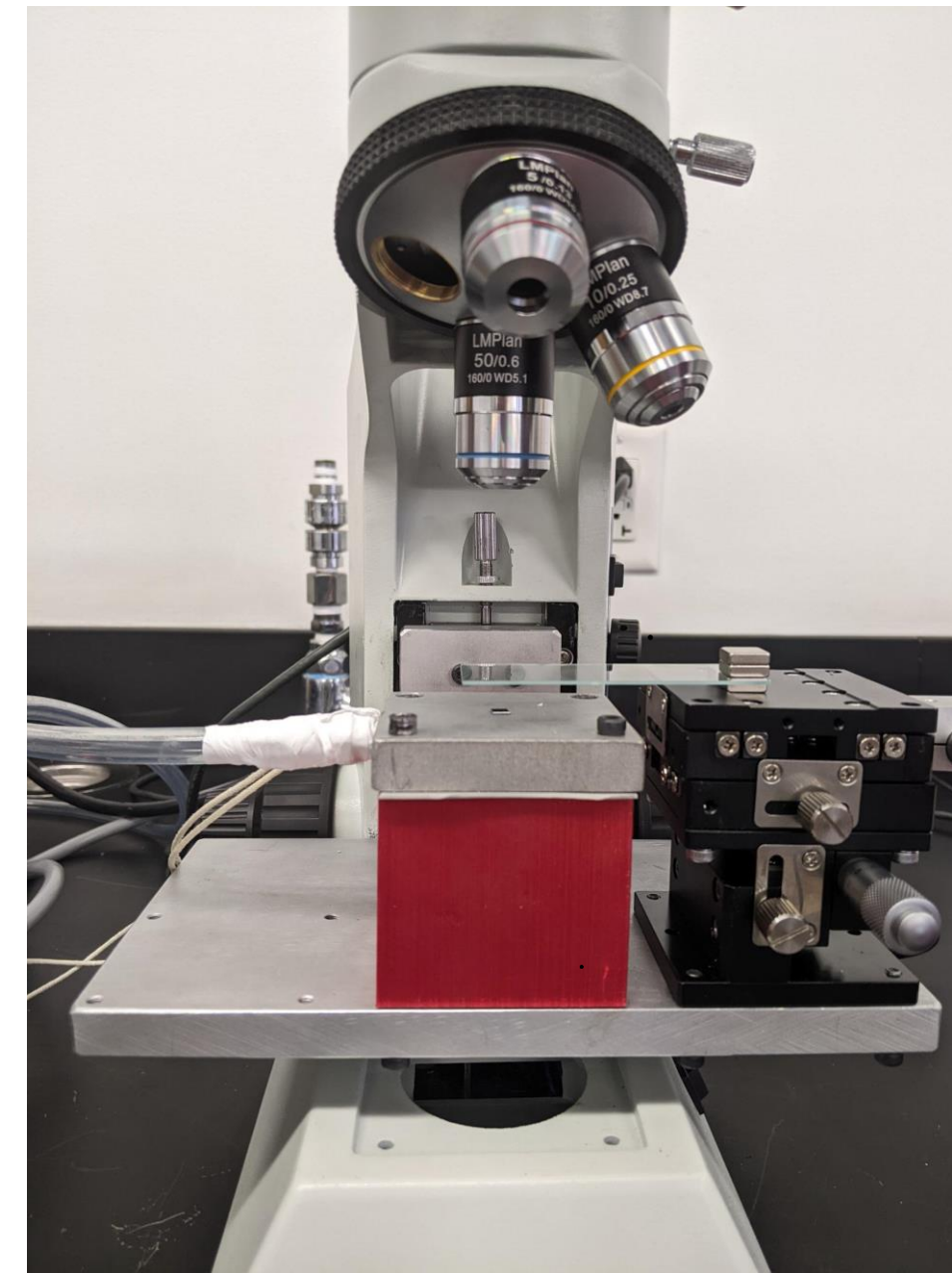


Figure 4: Platform attached to the optical microscope with the sample holder and micromanipulator

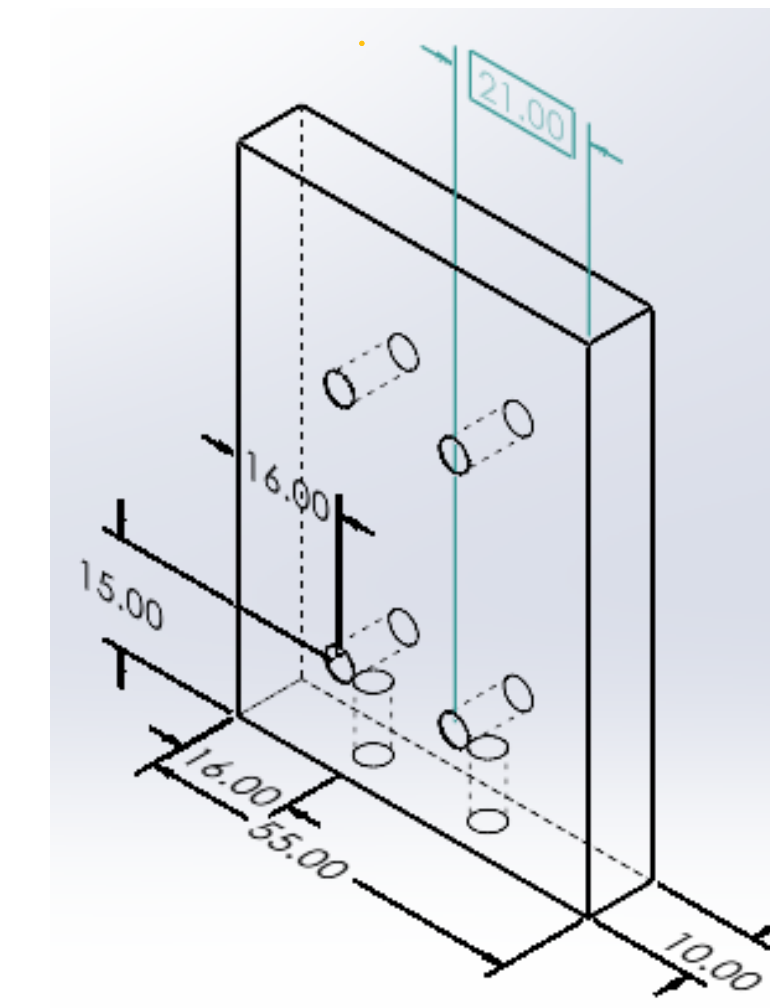


Figure 5: CAD diagram of platform attachment to microscope (units mm)

Design of the Sample holder

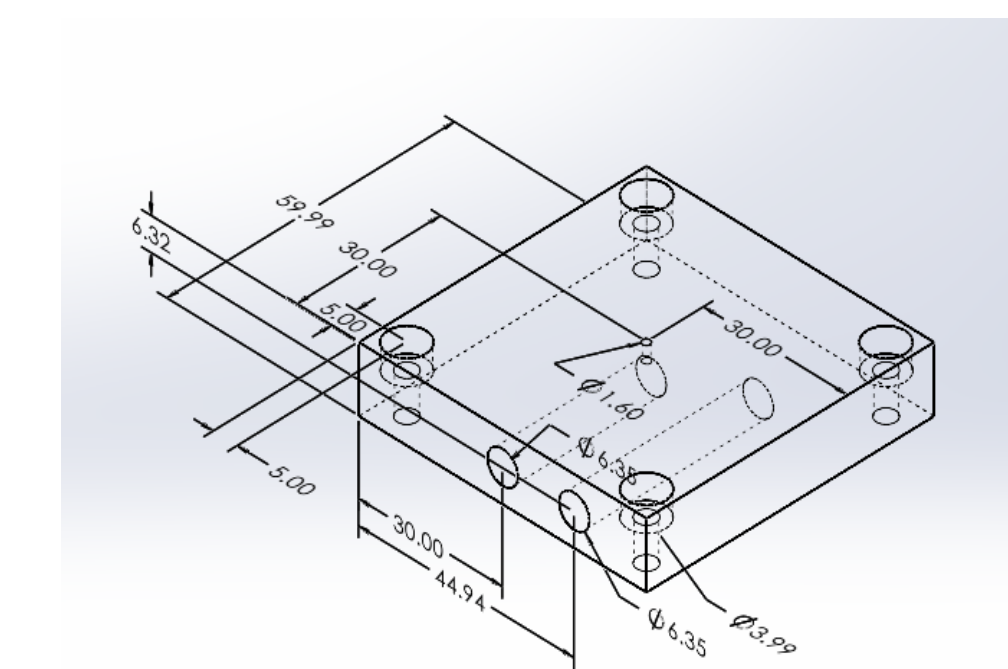


Figure 6: CAD diagram of the sample holder with dimensions shown (units mm)

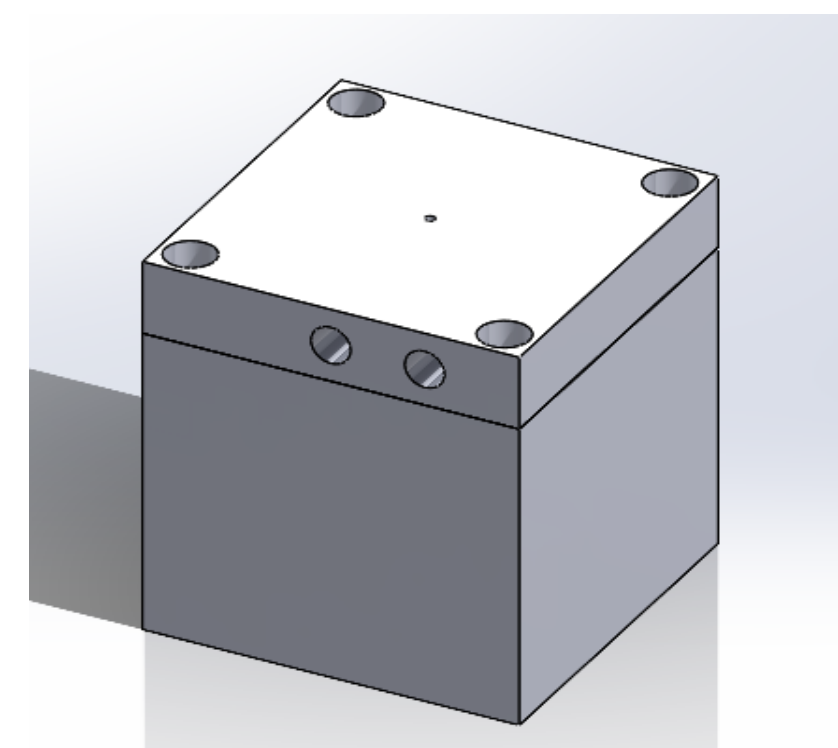


Figure 7: CAD diagram of the sample holder attached to a spacer

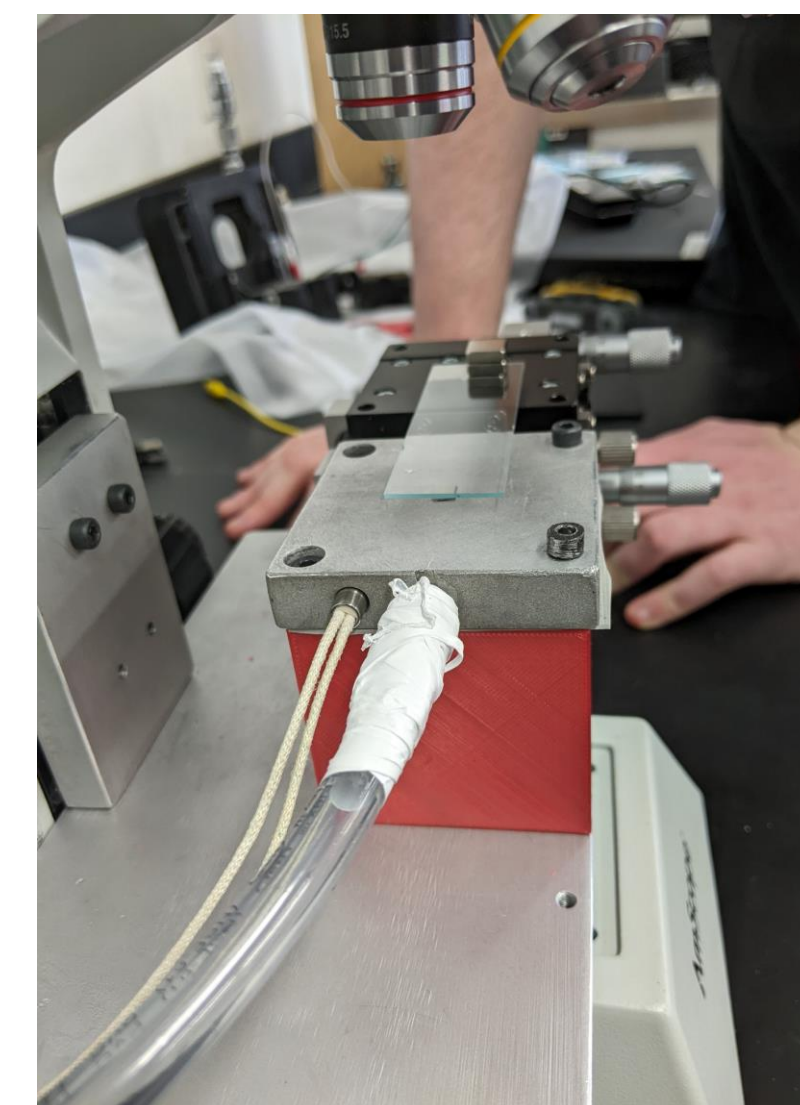


Figure 8: Sample holder attached to a spacer

Additional Components



Figure 9: Vacuum pump to hold substrate in place



Figure 10: PID controller used to manage temperature of the sample stage

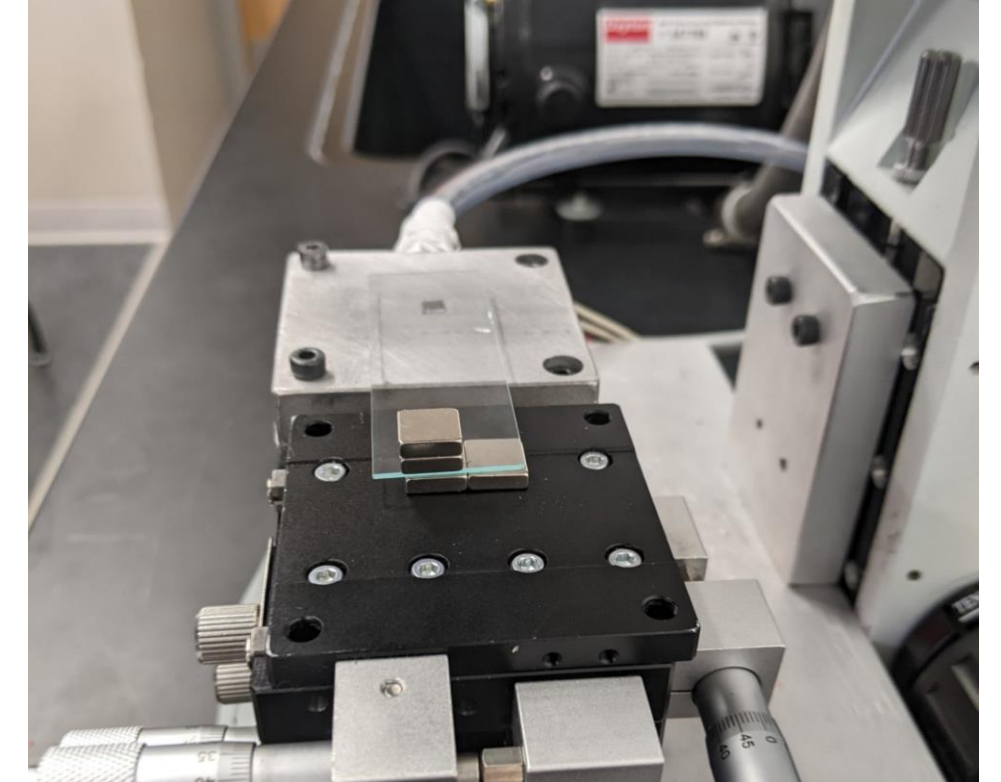


Figure 11: XYZ micromanipulator attached to the platform next to the sample holder. Magnet and glass slide used along with sticky polymer to pick up flakes

Completed transfer station

Figure 12: Completed vdW transfer station consisting of optical microscope attached with all necessary components to effectively observe and transfer vdW flakes

