Open Science Hardware Setup for investigating the Stability of Organic Solar Cells - Interim Report

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Chapter 1

Mechanical Design

The design of the container was a process that encompassed several months. This chapter will go through the entire mechanical design process, outlining the key aims, decisions and analysis behind the container design.

During the mechanical design process, there were two different software's used: OpenSCAD and SOLIDWORKS. OpenSCAD is an open source software which is compatible with all major computer operating systems. This enabled the start of the design process to occur before the beginning of the Michaelmas Term. Furthermore, as mentioned in the introduction, using opensource software is a key tenant of this project as it needs to be replicable for teams worldwide. SOLIDWORKS however, is not open source, but was still used. This is because there is some key functionality in SOLIDWORKS which helps reduces the time needed on a few of the important steps (such as rendering photos, heat simulations and producing engineering drawings). However, as I will lay out further in the chapter, the main designs were completed on OpenSCAD, and they do hold enough information for a group elsewhere to replicate without significant difficulty.

A key consideration was what processes would be needed for the manufacturing of the container. The engineering department has different facilities which could be useful including: a workshop with a CNC machine, multiple different3D printers, a mechanical workshop which I would be able to use along with an electrical workshop. These all were considered when designing the container and each will be mentioned during this chapter.

The first stage of the design process was to outline a specification for the testing container. These specifications were drawn from the project brief, the literature review and discussion with my supervisor Professor Moritz Riede. The specification of the design is outlined below:

1. The container must be able to accommodate a 30 mm x 30 mm substrate provided by AFMD research group.

2. The container must be leakproof to outside air.
3. The container must allow electrical connections from outside to connect to the substrate for measurements.
4. The container must enable the substrate to be heated to a given temperature[1].
5. The container must have a window allowing light to be shone into the box.
6. The container must contain a gas inlet.
7. The container should fit into the small glovebox inlet with diameter 150 mm.

This specification is a clear guide to what functionality there needs to be within the container, as well as any size limitations. As mentioned in both the introduction and literature review, is is essential for the container to be leakproof, to ensure that the solar cell does not degrade due to atmospheric O2 and water vapour. This would result in flawed results due to the cell having some unmeasured degradation before the experiments even begin. Another important point in the specification is the ability of the cell to be heated to a given temperature*. This functionality is important as its role is to attempt to emulate a lifetime (20 years) of temperature degradation in the space of 3 months.

The gas inlet is another feature to enhance the degradation. This will be used to create a 'cocktail' of different gases (guided by the literature) to try and emulate lifetime degradation of the solar cell. The last point on the specification is to ensure the ease of use with the AFMD research group. The gloveboxes they use have a small inlet with a diameter of 150 mm, using this would vastly reduce the time needed to insert the solar cell into the testing container.

[1] The reason for a none specific temperature