Ultrasonic bonding of aluminium ribbons to molybdenum back contacted CIGS modules

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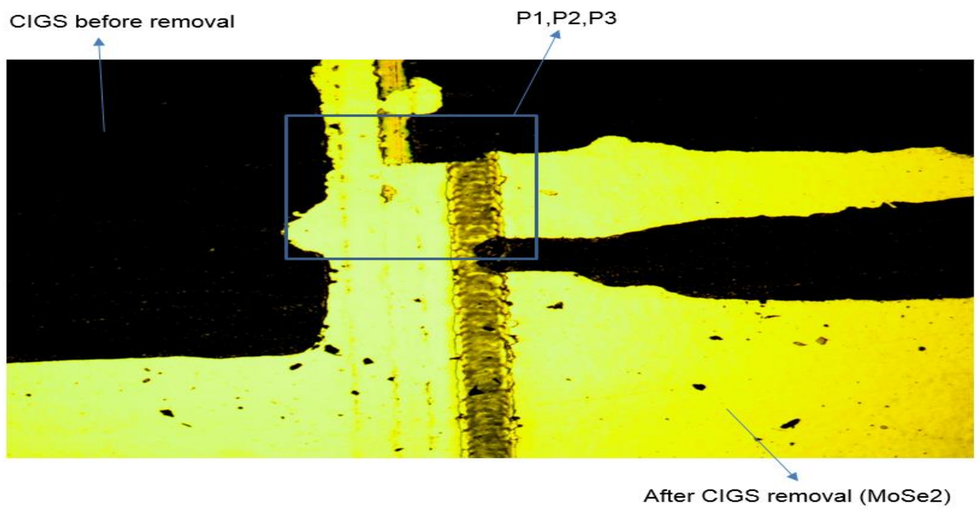
Introduction

The connection of the output terminals of thin film photovoltaic (TFPV) modules with a molybdenum (Mo) back contact is challenging because of the molybdenum diselenide ($MoSe_2$) layer which is formed during the selenization process. $MoSe_2$ is known to be highly resistive and previous research showed that high temperature soldering is not favourable for CIGS. In this work, we present the possibilities of ultrasonic bonding in order to create a low resistive and reliable connection of the output terminals.

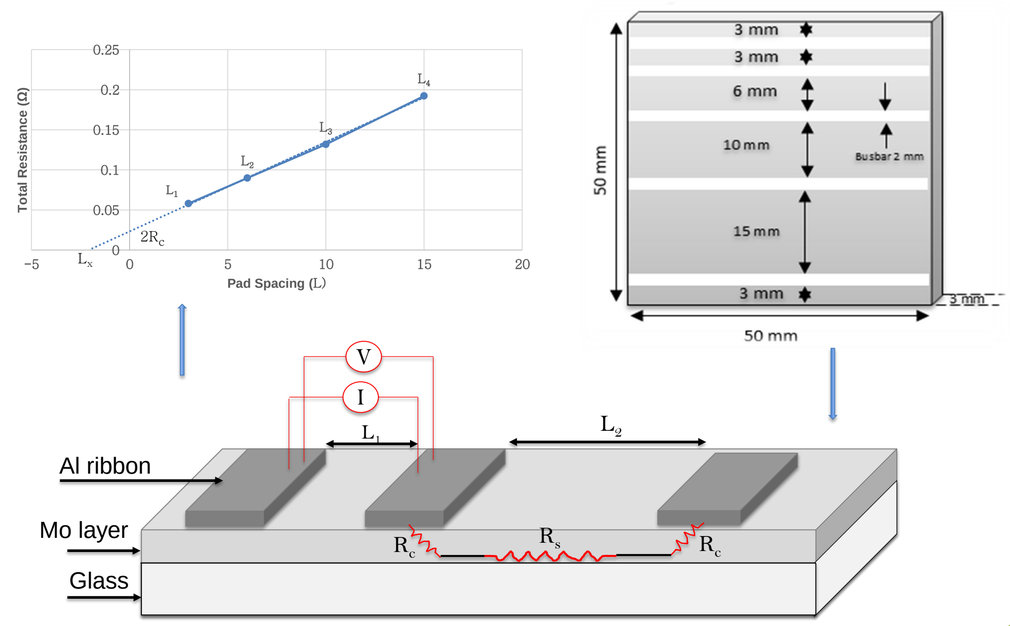
Sample preparation

In order to interconnect TFPV modules, a complete removal of the CIGS layer without damaging the Mo layer underneath is necessary. In this work the CIGS stack was removed mechanically. Literature has shown that the $MoSe_2$ layer can remain present after mechanical brushing.



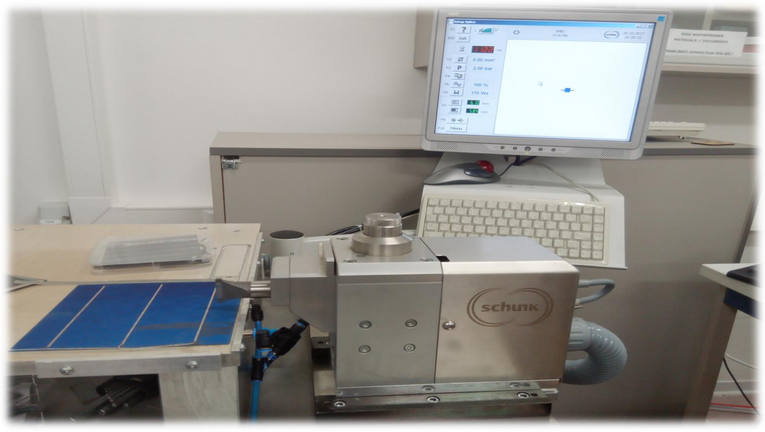
Measurement method

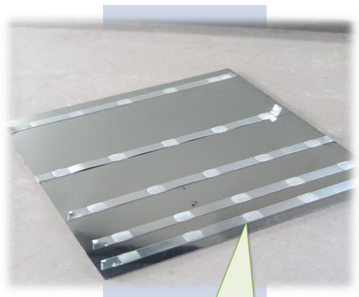
The transmission line method (TLM) was used to measure Rc between the ribbon and the Mo layer. The four-point method was used to measure the resistance in the TLM measurements[1].

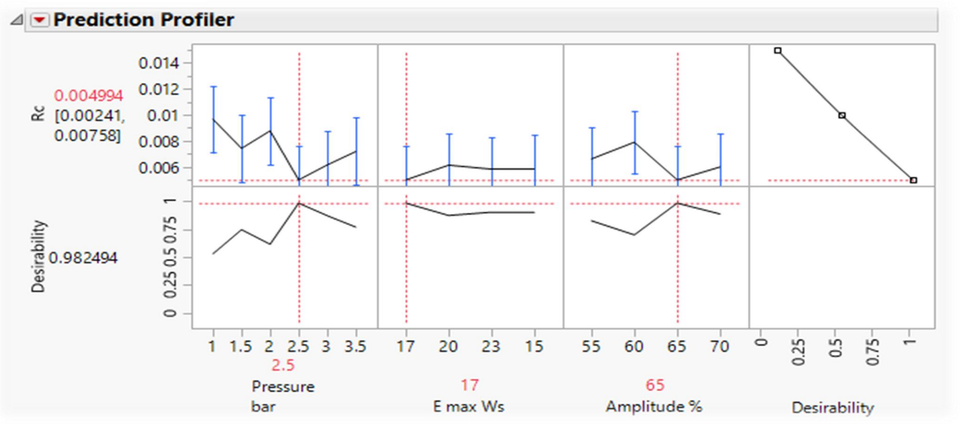


Experimental realization

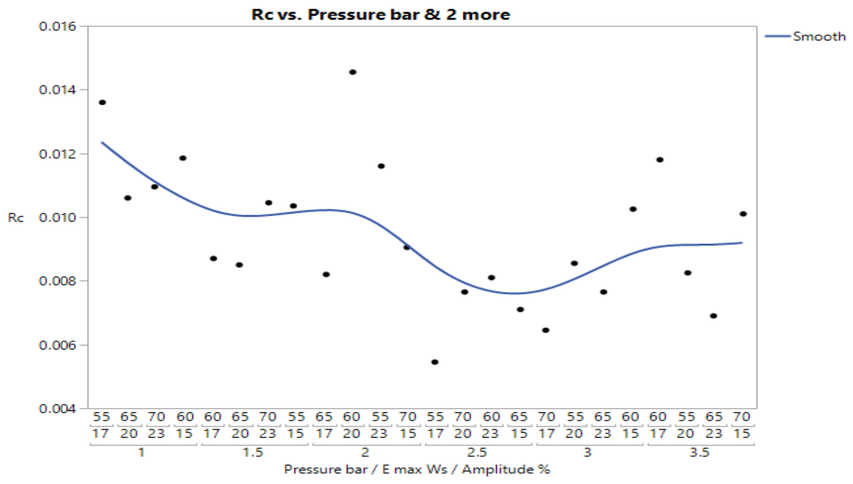
A Schunk DS-35 ultrasonic bonder was used. Ultrasonic bonding has three main variables that have an impact on welding quality which are; pressure, amplitude and maximum energy. Each parameter has a different impact on the interconnection. By changing the parameter values and measuring the Rc between Mo and the Al ribbon the interconnection quality can be optimized. Design of experiment (DOE) in JMP software was used for optimal parameter prediction







Variables impacts - Graph builder of Rc



Conclusion

As a result of ultrasonic bonding tests that have been performed it can be concluded that the pressure has the highest impact on Rc, while the maximum energy has the lowest impact.

Future potential

- Peel tests will be carried out to identify the optimal ultrasonic parameters that give good pull strength in a 90° peel test.
- Thermal cycling will be applied to investigate the influence of thermal mismatch on the Rc and pull strength

Reference

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