

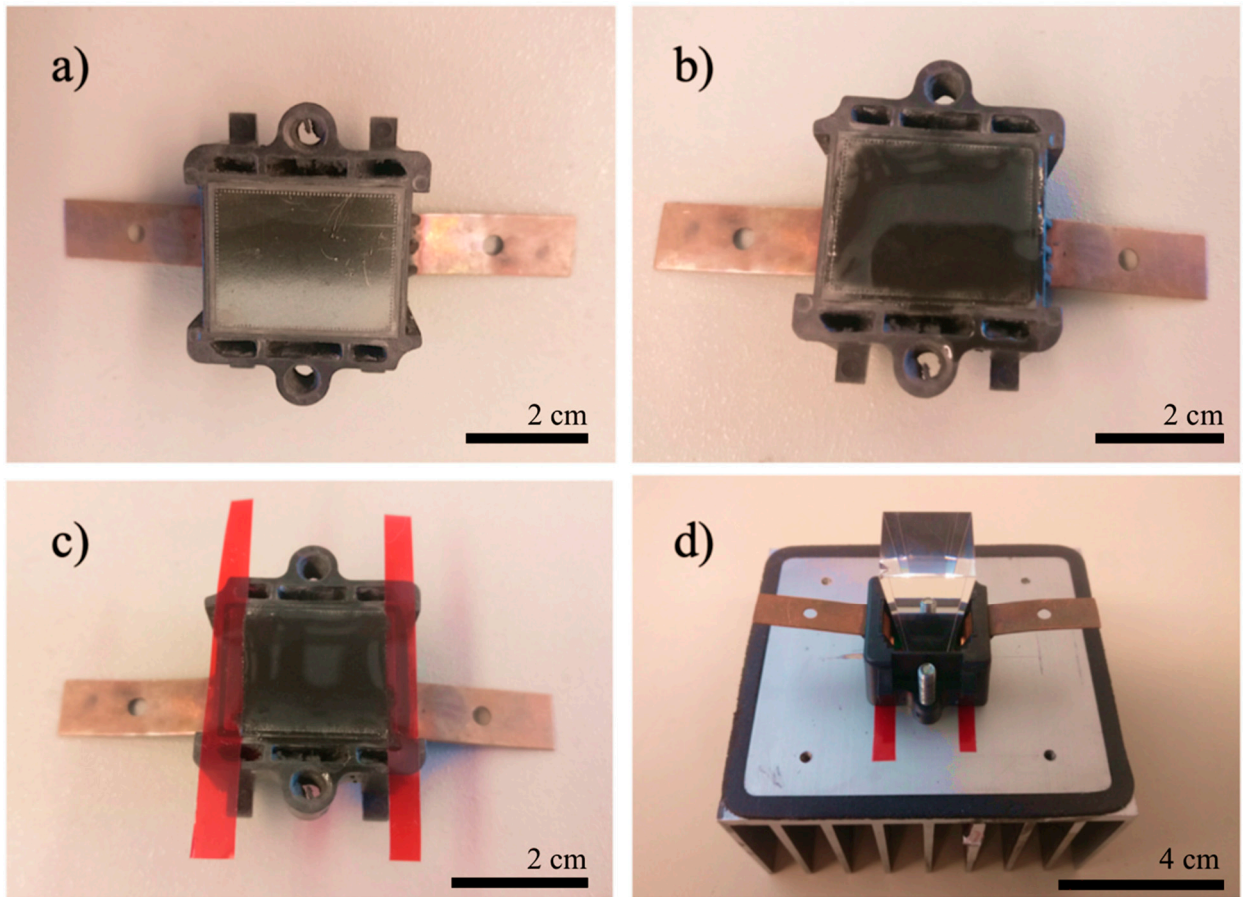
# Supplementary Materials: Non-Curing Thermal Interface Materials with Graphene Fillers for Thermal Management of Concentrated Photovoltaic Solar Cells

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## I. Sample preparation and experimental setup

The pre-determined amounts of graphene flakes were measured in order to synthesize 10 wt%, 20 wt%, 40 wt% mixtures in mineral oil samples. It was then added to 20–30 mL of acetone to create a uniform suspension. The acetone–graphene mixture was used to avoid possible graphene agglomeration in mineral oil if otherwise added directly. The samples were sheer mixed at a low rate (800 RPM) for 15 min, to retain the lateral dimensions of the flakes. Following the sheer mixing, the graphene mineral oil slurries were decanted at 70 °C for two hours, removing the excess acetone with a graphene enhanced-TIM remaining.

The multijunction solar cell's back surface was cleaned using acetone. The TIM layer was then applied uniformly. In order to maintain a constant bond layer thickness, plastic shims of 54  $\mu\text{m}$  thickness were used at the edge of the solar cells. Solar cell with TIM and shims attached was then bolted to the heat sink with a thermocouple attached at the bottom of the solar cell (see Figure S1). Aluminum heat sink manufactured by extrusion with dimensions of 90mm  $\times$  95 mm  $\times$  50 mm was used. A convex lens was used for converging the 1 sun power on to the 1  $\text{cm}^2$  multi-junction solar cell. The distance between the solar cell and lens was changed in order to achieve the optimum illuminations on the solar cell. Additional secondary optical elements (SOEs), like truncated square prism glass, were used to focus the light on the multi-junction solar cell. A multi-meter was attached to the solar cell with the probes. It was set up to measure and record the open-circuit voltage every five seconds once the solar simulator's illumination was turned on.



**Figure S1.** (a) Solar cell cleaned with acetone; (b) TIM uniformly applied on the back surface; (c) shims attached to the edges of solar cell, and (d) solar cell bolted to the heat sink with SOE on top.



**Figure S2.** Actual experimental setup working at 70 suns illumination with multi-meter recording the open-circuit voltage.