

THIS ISSUE

MANUFACTURING SOLAR CELLS

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History

- Our first application note regarding solar cells was published in 1999 - 23 years ago. At that time, the solar industry was estimated to be \$750 million with an annual growth rate of 20%. Today, the worldwide industry is more than \$50 billion strong and is expected to reach \$200 billion by 2026.

Bringing this a little closer to home, the US solar manufacturing market is currently around \$12 billion. This was projected to increase by 9-11% in 2022 but will likely miss that goal due to supply chain issues related to the COVID-19 pandemic.

What are solar cells and how do they work?

In basic terms, solar cells are devices which convert solar energy into electricity. They are generally made from semiconductors like silicon and are also referred to as “photovoltaic cells” which means “producing a voltage when exposed to radiant energy such as light.” This energy is transferred to the semiconductor, exciting the electrons, and causing current to flow. Metal contacts on the top and bottom of the solar cell then draw the current off as useful energy.

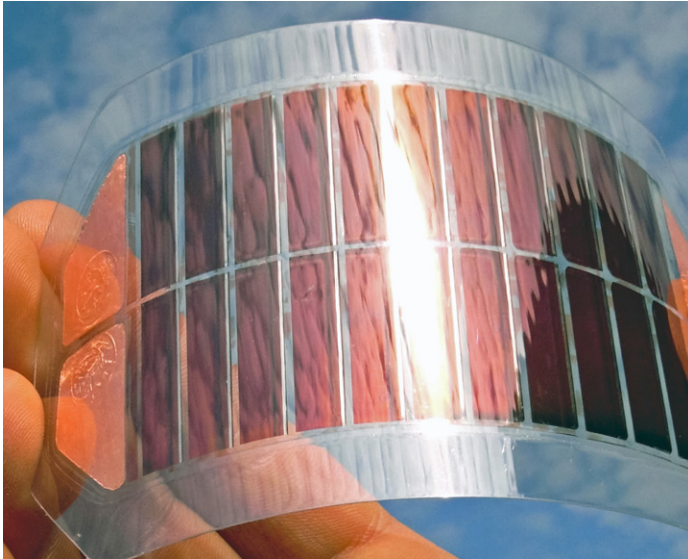


Where are they used?

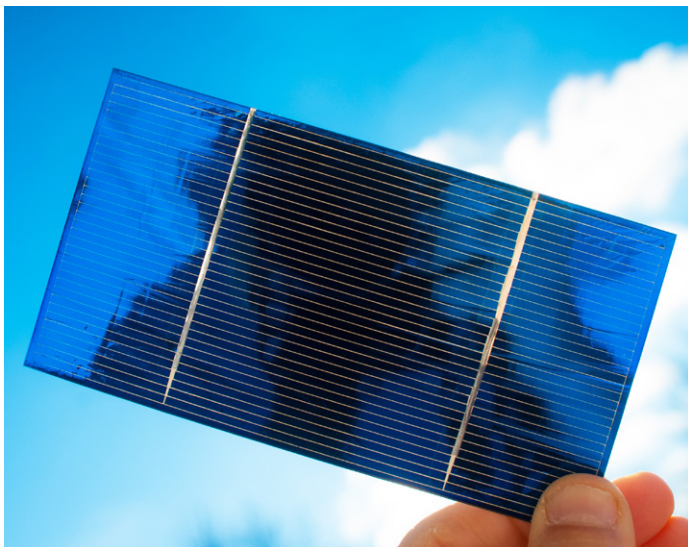
Industry growth in North America is primarily in utility-scale projects as pictured above (a utility-scale solar facility is one which generates solar power and feeds it into the grid, supplying a utility like Southern California Edison with energy), followed by commercial (pumping water, illuminating road signs, street lights, etc.), and residential. In addition, the recent launch of the long-awaited 5G network is increasing the demand for solar cells to be installed on low orbit satellites and launched into space to create and support this new 5G technology which will change the world as we know it today: “from manufacturing facilities maintained by hundreds of connected robots to automobiles that self-diagnose and update repairs on their own, 5G is set to become the basis for all things connected.”¹

¹ Ran Poliakine, Forbes Councils Member. <https://www.forbes.com/sites/forbestechcouncil/2021/08/12/what-you-should-know-about-5g-technology-and-what-the-future-holds/?sh=169de021636b>

How are they made?



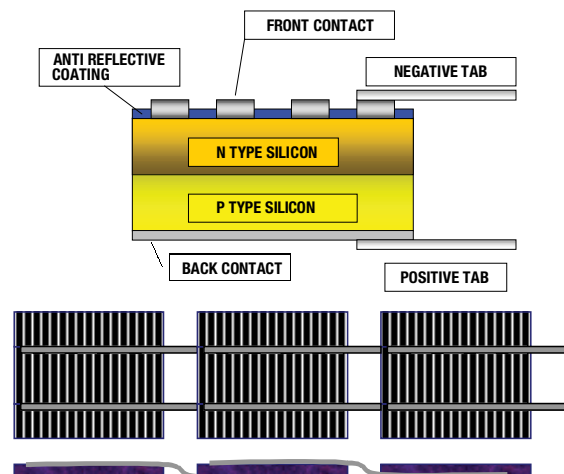
Thin Film Solar Technology



Silicon Wafer Solar Technology

The typical solar cell is comprised of two layers of silicon: the “P” layer and the “N” layer. The “P” type silicon is backed by a solid metallic layer which forms the positive contact. The “N” type silicon has an anti-reflective coating on it, which, in turn, has a metallic lattice bonded to it, forming the negative current path.

Two styles of manufacturing technologies are prevalent: wafer technology (crystalline silicon) and thin film technology. The contact surface metallization is made from various alloys including tin and silver. Regardless of the technology used to manufacture them, each cell is electrically connected to another cell by means of either a ribbon or a tab. The ribbon or tab material connects the top of one cell to the bottom of another, and is usually tinned or silver plated for solderability. Solar cells are joined together in strings to make up a solar module. Cell strings can be arranged in parallel or series arrangements.



The top and bottom of adjacent cells are joined in strings using ribbon or tab connections

Cell modules are supported in an array by a metal honeycomb structure. Panels are then connected to one another via a junction box (aka JBox or PV combiner box). Junction boxes, which are typically pre-installed on the panel, are enclosures which house all of the electrical bits. JBoxes collect DC power from PV strings with blocking diodes on each string to protect panels from reverse current flow. The collected power is then transferred to inverter to be converted into AC.

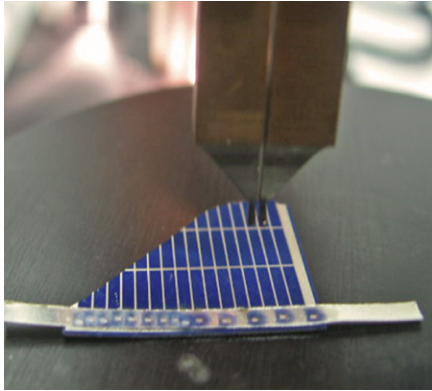
What are the various solar cell manufacturing applications and how can they be achieved?

For each of the applications listed, AMADA WELD TECH offers a production solution: resistance welding, laser welding, laser marking, laser cutting and hot bar reflow soldering and bonding. We have in-depth knowledge of, and experience with each category and application, including welding ribbons to cells, joining flexible circuits to glass, scribing cells, marking for identification and more.

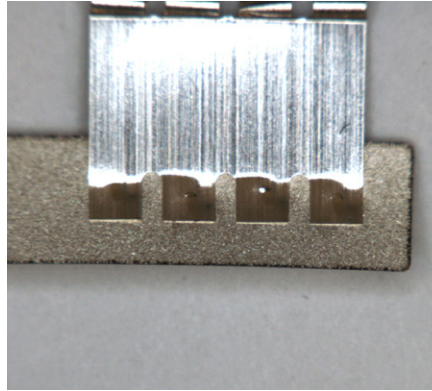
Our in-house applications labs enable proven processes to be delivered with optimized systems.

Application	Manufacturing Technology					
	Resistance Welding	Resistance Brazing	Hot Bar Reflow Soldering	Laser Welding	Laser Marking	Laser Scribing
Welding Ribbon to Cell	X					
Welding Tab to Cell	X					
Joining Flex Circuit to Glass			X			
Welding Lead to Terminal	X	X		X		
Welding Ribbon to Busbar	X					
Scribing Cells						X
Welding Thin Film	X			X		
Marking					X	
JBox	X	X				

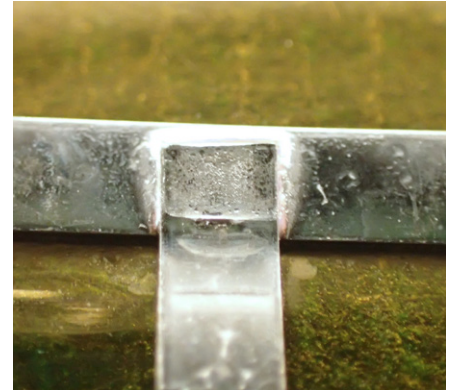
Typical Applications



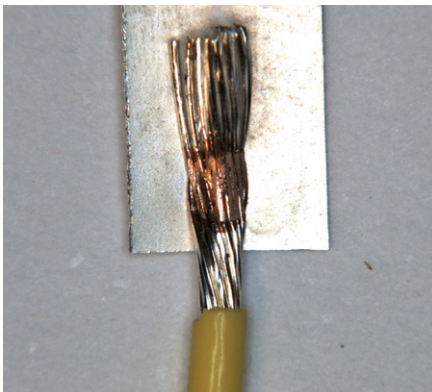
Welding Ribbon to Cell



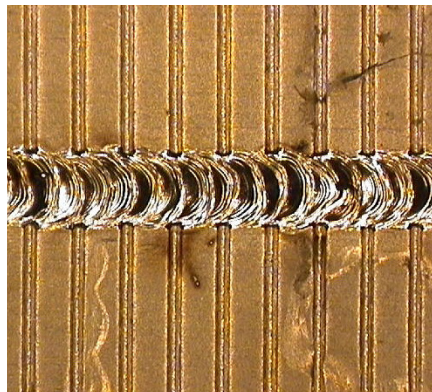
Welding Tab to Cell



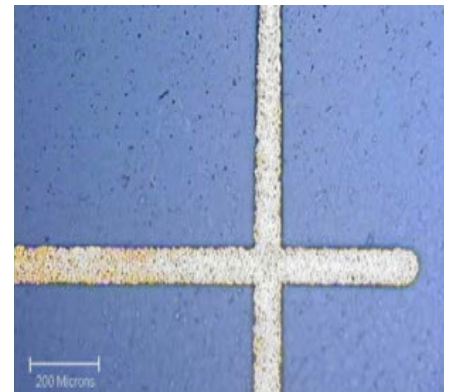
Reflow Soldering Ribbon to Busbar



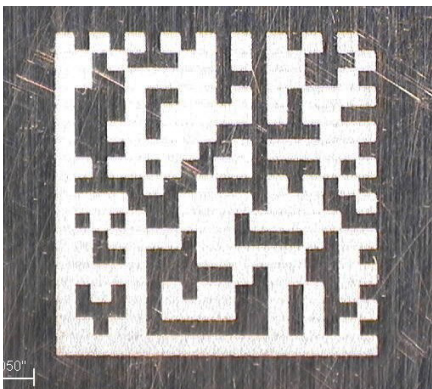
Welding Lead to Terminal



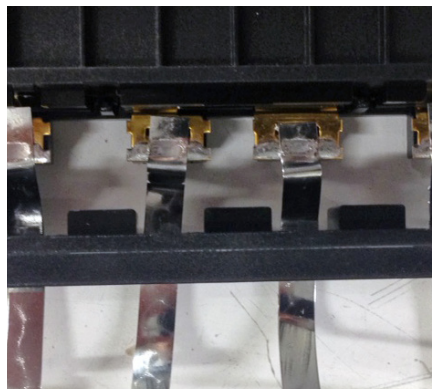
Laser Welding Lead to Terminal



Scribing Cells



Laser Marking Cells



Welding JBox Connections