natcoretechnology
advancing solar science

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Natcore is in the final stages of developing an all-back-contact cell in which the metallization is a multilayered aluminum foil, as opposed to the standard interdigitated back contact (IBC) approach. The use of a multilayer structure, combined with the extremely low cost of aluminum, provides significant cost savings:

- We currently estimate that total metal cost for a 156 mm cell made with Natcore's approach would be under $0.01. This is estimated from prices of commercially available aluminum-polymer-aluminum laminates[i]. Assuming a laminate cost of $2.70 per kilogram, the ~3.1 g of laminate used for a 156 mm cell would cost approximately **0.8 ¢/cell**. About 0.5 ¢/cell of that cost is due to the cost of aluminum[ii].

- Standard industry cells (not all-back-contact) utilize screen printed silver pastes. According to the International Technology Roadmap for Photovoltaics[iii], current cells use about 100mg of silver per cell, and that number is projected to drop to about 50mg per cell by 2024. Some important considerations:
    - 100mg per cell at today's silver price ($0.52/gram[iv]) costs **5.2 ¢/cell**.
    - These prices are only for the actual silver metal price, and thus do not include the mark-up cost of the pastes that are used, or the cost of any processing to apply silver to the cell.
    - Even though silver usage per cell is expected to drop in the future, as the volume of the solar industry expands it will eventually drive up silver prices.
    - The reduction in silver usage will likely be achieved with other technologies (plating, SmartWire Connection Technology (SWCT)). However, there is some cost added back with these approaches.

- Interdigitated back contact cells have higher efficiency but typically require even more silver than standard cells.
    - A 156 mm cell using silver metallization would require about 500 mg per cell[v] to achieve the same resistance contribution as estimated for our foil cell
    - The associated silver cost is therefore about **26 ¢/cell**.

Efficiency: Our best laboratory cells are just under 21% efficient. However, these cells are limited by aspects of the laboratory process such as the type of base contact used—not aspects that are integral to our process. The most important take-away is that the cell design is a fully passivated-contact design, and thus capable of efficiencies >24%.

Module Incorporation: There are two big advantages to our cell in modules: (1) Cells can be directly connected to each other without additional conductors (like tabbing, solders, or circuitized backplanes), leveraging instead simple patterning of the foils that are part of the cells; (2) Because relatively thick foils can be used, resistive losses contributing to cell-to-module loss can be reduced.

In summary, the Natcore foil approach offers a cell metallization cost that is considerably lower than current or projected standard cells. The cost differential gets even larger when considering that the Natcore foil cell is a back contact cell, and thus comparing to other back contact approaches. Thus, the multilayer foil approach can deliver high efficiency back contact architecture with metallization cost below that of standard cells.

We are now at a stage in our foil cell development that identifying a partner has become a priority. Dr. David Levy and Dr. David Carlson recently co-authored a paper describing the basics of this technology (I have attached a copy of that paper). The paper was presented at the recent IEEE-PVSC Meeting in Washington, D.C. and was well received at a variety of levels -- commercial, academic and governmental. I am taking advantage of that positive reception to start aggressively pursuing partners.

[i] Typical example: Commercially available Al-PET-Al laminate from Hangzhou Dongxing Telecommunication Material Co., Ltd. (Model: DX17071521), $2.50-$3.50 per kilogram. Cell estimate assumes 20μm Al / 12 μm PET / 20 μm Al laminate.
[ii] 0.97 gram aluminum per cell, aluminum price $0.86/lb (2017-07-14)
[iii] ITRPV, 8th Edition, March 2017
[iv] Silver spot price, 2017-07-14
[v] Internal calculation assuming 1mm line pitch and 0.4mm lines for both contacts, to achieve 0.4 mW/cm2 power loss at 40 mA/cm2 current.