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Modeling and characterization of high-efficiency silicon solar cells fabricated by rapid thermal processing, screen printing, and plasma-enhanced chemical vapor deposition

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P. Doshi ; J. Mejia ; K. Tate ; A. Rohatgi All Authors

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Abstract	<div><div></div><div>Downl</div><div>PDF</div></div> <div>Abstract:<p>This paper presents, for the first time, the successful integration of three rapid, low-cost, high-throughput technologies for silicon solar cell fabrication, namely: rap... View more</p><div><div></div><div>Metadata</div></div><div>Abstract:<p>This paper presents, for the first time, the successful integration of three rapid, low-cost, high-throughput technologies for silicon solar cell fabrication, namely: rapid thermal processing (RTP) for simultaneous diffusion of a phosphorus emitter and aluminum back surface field; screen printing (SP) for the front grid contact; and low-temperature plasma-enhanced chemical vapor deposition (PECVD) of SiN for antireflection coating and surface passivation. This combination has resulted in 4 cm/sup 2/ cells with efficiencies of 16.3% and 15.9% on 2 /spl Omega/-cm FZ and Cz, respectively, as well as 15.4% efficient, 25-cm/sup 2/ FZ cells. Despite the respectable RTP/SP/PECVD efficiencies, cells formed by conventional furnace processing and photolithography (CFP/PL) give /spl sim/2% (absolute) greater efficiencies. Through in-depth modeling and characterization, this efficiency difference is quantified on the basis of emitter design and front surface passivation, grid shading, and quality of contacts. Detailed analysis reveals that the difference is primarily due to the requirements of screen printing and not RTP.</p></div></div>
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- ☐ 1. J. Nijs, E. Demesmaeker, J. Szlufcik, J. Poortmans, L. Frisson, K. De Clercq, et al., "Latest efficiency results with the screenprinting technology and comparison with the buried contact structure", *Proc. 24th IEEE Photovoltaic Specialists Conf.*, pp. 1242-1249, 1994.
View Article  Google Scholar 
2. H. Nakaya, M. Nishida, Y. Takeda, S. Moriuchi, T. Tonegawa, T. Machida, et al., "Polycrystalline silicon solar cells with V-grooved surface", *Tech. Dig. Int. Photovoltaic Solar Energy Conf.*, pp. 91-92, 1993.
Google Scholar 
- ☐ 3. L. Verhoef, P.-P. Michiels, R. J. C. van Zolingen, H. H. C. de Moor, A. Burgers, R. Steeman, et al., "Low-cost multicrystalline silicon solar modules with 16% encapsulated cell efficiency", *Proc. 24th IEEE Photovoltaic Specialists Conf.*, pp. 1547-1550, 1994.
View Article  Google Scholar 
- ☐ 4. K. Fukui, H. Yamashita, M. Takayama, K. Okada, K. Masuri, K. Shirasawa, et al., "15 cm $\times$ 15 cm high efficiency multicrystalline silicon solar cell", *Proc. 22nd IEEE Photovoltaic Specialists Conf.*, pp. 1040-1044, 1991.
View Article  Google Scholar 
5. R. P. S. Thakur, "Thermal budget considerations in rapid isothermal processing", *Appl. Phys. Lett.*, vol. 64, pp. 327-329, 1994.
CrossRef  Google Scholar 
6. C. Leguijt, P. Lo"ngen, J. A. Eikelboom, A. W. Weeber, F. M. Schuurmans, W. C. Sinke, et al., "Low temperature surface passivation for silicon solar cells", *Sol. Energy Materials Sol. Cells*, vol. 40, pp. 297-345, Aug. 1996.
CrossRef  Google Scholar 
7. R. Gonsiorawski and G. Czernienko, *Method of fabricating solar cells with silicon nitride coating*, June 1988.
Google Scholar 
8. *Product information regarding RTP solar cell furnace*.
Google Scholar 
- ☐ 9. P. Doshi, A. Rohatgi, M. Ropp, Z. Chen, D. Ruby and D. L. Meier, "Rapid thermal processing of high-efficiency silicon solar cells with controlled in-situ annealing", *24th IEEE Photovoltaic Specialists Conf.*, pp. 1299-1302, 1994.
View Article  Google Scholar 

10. A. Rohatgi, P. Doshi, M. Ropp, L. Cai, W. A. Doolittle, S. Narasimha, et al., "Improved understanding and optimization of RTP and PECVD processes for high-efficiency silicon solar cells", *13th Europ. Photovoltaic Solar Energy Conf.*, Oct. 1995.
Google Scholar 

- ☐ 11. P. Doshi, J. Mejia, K. Tate and A. Rohatgi, "Integration of screen-printing and RTP technologies for silicon solar cell fabrication", *IEEE Electron Device Lett.*, vol. 17, pp. 404-406, Aug. 1996.
View Article  Google Scholar 

- ☐ 12. P. Doshi, J. Mejia, K. Tate, S. Kamra, A. Rohatgi, S. Narayanan, et al., "High-efficiency silicon solar cells by low-cost rapid thermal processing screen-printing and plasma enhanced chemical vapor deposition", *Proc. 25th IEEE Photovoltaic Specialists Conf.*, 1996.
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13. S. Narasimha, J. Mejia and A. Rohatgi, "Screen-printed aluminum back surface fields for silicon solar cells", *6th Workshop Role Impurities Defects Silicon Device Processing*, Aug. 1996.
Google Scholar 

- ☐ 14. P. Basore, "PC-1D version 3: Improved speed and convergence", *Proc. 22nd IEEE Photovoltaic Specialists Conf.*, pp. 299-302, 1991.
View Article  Google Scholar 

- ☐ 15. S. Sivoththaman, W. Laureys, P. Schepper, J. Nijs and R. Mertens, "Rapid thermal processing of conventionally and electro-magnetically cast 100 cm $\times$ 2 multicrystalline silicon", *Proc. 25th IEEE Photovoltaic Specialists Conf.*, 1996.
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- ☐ 16. P. Doshi and A. Rohatgi, "18% efficient silicon photovoltaic devices by rapid thermal diffusion and oxidation", *IEEE Trans. Electron Devices*.
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17. L. Cai, *Improved understanding and control of the properties of SiN films and its applications to silicon solar cells*, 1997.
Google Scholar 

18. D. K. Schroder, "Contact resistance and schottky barrier height", *Semiconductor Material and Device Characterization*, pp. 114-121, 1990.
Google Scholar 

19. N. Wyeth, "Sheet resistance component of the series resistance in a solar cell as a function of grid geometry", *Solid State Electron.*, vol. 20, pp. 629-634, 1977.
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20. D. E. Kane and R. M. Swanson, "Measurement of the emitter saturation current by a contactless photoconductivity decay method", *Proc. 18th IEEE Photovoltaic Specialists Conf.*, pp. 578-583, 1985.
Google Scholar 

21. P. L  ngen, *Surface and volume recombination in silicon solar cells*, pp. 58-59, 1995.
Google Scholar 

22. S. Naryanan and M. Green, "Improvement in the open-circuit voltage and efficiency of silicon solar cells by rear aluminum treatment", *Sol. Cells*, vol. 26, pp. 329-334, 1989.
CrossRef  Google Scholar 

23. P. Hahne, W. Wettling and R. Schindler, "Aluminum back surface field doping profiles by conventional and rapid thermal processing", *12th Europ. Photovoltaic Solar Energy Conf.*, 1994.
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