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Nano/micro hybrid structure silicon solar cells with 17.6% power conversion efficiency

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We developed a unique nano/micro hybrid structure by selectively modifying only the top of a microwire using metal-assisted chemical etching. The fabricated nano/micro hybrid structure not only minimized surface recombination but also absorbed 97% of incident light under AM 1.5G illumination, demonstrating outstanding light absorption compared to that of planar (59%) and microwire arrays (85%). We report on high-efficiency Si nano/micro hybrid structure solar cells with areas of 1 cm² and a power conversion efficiency (E_{ff}) of up to 17.6% under AM 1.5G illumination. In particular, the solar cell shows a high short-circuit current density (J_{sc}) of 39.5 mA·cm⁻², because of the high light-absorbing characteristics of the structure. This corresponds to an approximately 61.5% and 16.5% increase in efficiency compared to that of a solar cell ($E_{ff} = 10.9%$) based on the planar silicon structure and a solar cell ($E_{ff} = 15.1%$) based on the microwire arrays, respectively. Hence, we expect the nano/micro hybrid structure developed through this study to become a foundation technology for the development of cost-effective and highly efficient solar cells.