Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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# Silicon-Cored Tungsten Nanowire as Selective Metamaterial Absorbers for Enhanced Solar Thermal Energy Conversion

## Inventors

Liping Wang
Jui-Yung Chang
Sydney Taylor

## Contact

Shen Yan
shen.yan@skysonginnovations.com

Background For efficient harvesting of solar energy to heat, spectrally selective absorbers with high solar absorption and low infrared emission are highly desired. Currently available absorbers are based on multilayer, periodic tungsten convex or concave gratings, nickel nanopyramids and tungsten nanowires/doughnuts, and nanoporous or nanoparticle composite structures.  These materials are expensive to fabricate due to the need for advanced techniques such as electron-beam lithography and focused-ion beam. Cost-effective methods involving direct printing and interference lithography have been successfully employed for fabricating centimeter-scale selective metamaterial absorbers. Even so, simpler and more cost-effective methods are still desired for large-area manufacturing of selective metamaterial solar absorbers. So far, systematic laboratory-scale solar-thermal characterization of nanostructured metamaterial selective solar absorbers under variable solar irradiation have rarely been demonstrated. Invention Description Researchers at National Chiao Tung University and Arizona State University have developed a silicon-cored tungsten nanowire selective metamaterial absorber to enhance solar-thermal energy harvesting. After conformally coating a thin tungsten layer about 40 nm thick, the metamaterial absorber exhibits almost the same total solar absorptance, 0.85, as the bare silicon nanowire stamp but with greatly reduced total emittance, 0.18, due to suppressed infrared emission heat loss. The silicon-cored tungsten nanowire absorber achieves an experimental solar-thermal efficiency of 41% at 203°C during a laboratory-scale test with a stagnation temperature of 273°C under 6.3 suns. Without parasitic radiative losses from side and bottom surfaces, efficiency is projected to reach 74% at the same temperature of 203°C with a stagnation temperature of 430°C, greatly outperforming silicon nanowire and black absorbers. The results would facilitate the development of metamaterial selective absorbers at low cost for highly efficient solar-thermal energy systems. Potential Applications •    Solar-thermal energy systems Benefits and Advantages •    Increased conversion efficiency – Tungsten coating allows for high solar absorption with decreased thermal infrared emission •    Simple fabrication and lower cost compared to current metamaterial absorbers Related Publication: Enhancing Solar Thermal Energy Conversion with Silicon-Cored Tungsten Nanowire Selective Metamaterial Absorbers (PDF)Research Homepage of Professor Liping Wang