Blackening copper opens new applications

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(Phys.org)—Copper is one of the world's most widely used metals. Now researchers at the University of Dundee have found that blackening copper using industry-standard lasers could make it even more adaptable and efficient.

Professor Amin Abdolvand and colleagues at Dundee have discovered that intense nanosecond pulses of laser light can be used to transform copper's characteristically lustrous surface to a deep, absorbent black, making it even more effective for many technical applications.

The laser they used is industrially adaptable. Previously it was thought that only much more expensive lasers (ultra-short pulsed lasers) could be used to make metals appear black, thereby making the process impractical for industrial use.

"By making copper so much more light- and heat-absorbent it means we can do so much more with it," said Professor Abdolvand. "Because copper is normally shiny it reflects most of the light back. Blackening it allows it to absorb light throughout a broad spectrum, making it far more effective.

"This technique for fabrication of black copper could find applications in broadband thermal radiation sources, solar energy absorbers, irradiative heat transfer devices, and thermophotovoltaics.

"Copper and its alloys and metals with similar metallurgical behaviour are important materials for many technical applications due to their unrivalled thermal and electrical conductivity. Affordable and practical routes for processing of such metals are essential for us to meet our ever growing energy demands and much higher electrification of our everyday lives."

The results of the research have been published in the December issue of *Applied Physics Letters* and also highlighted by Physics Today.

By stepping the laser beam over the surface of the copper, Professor Abdolvand and colleagues were able to modify the properties of the copper. Under a microscope the modified surface resembles an upturned egg carton whose individual dimples have been pushed in.

The researchers tested various firing patterns for the laser before finding the most effective pattern, which gave the greatest boost in absorption. The absorption boost is attributed to several mechanisms, including light-trapping in microcavities.

"Importantly we are able to exercise full control over the structuring process, using nanosecond lasers. These lasers are already used widely in industry, so the process is one we think could have widespread application."

Provided by University of Dundee