Heat transport can be blocked more effectively with a more optimized holey nanostructure

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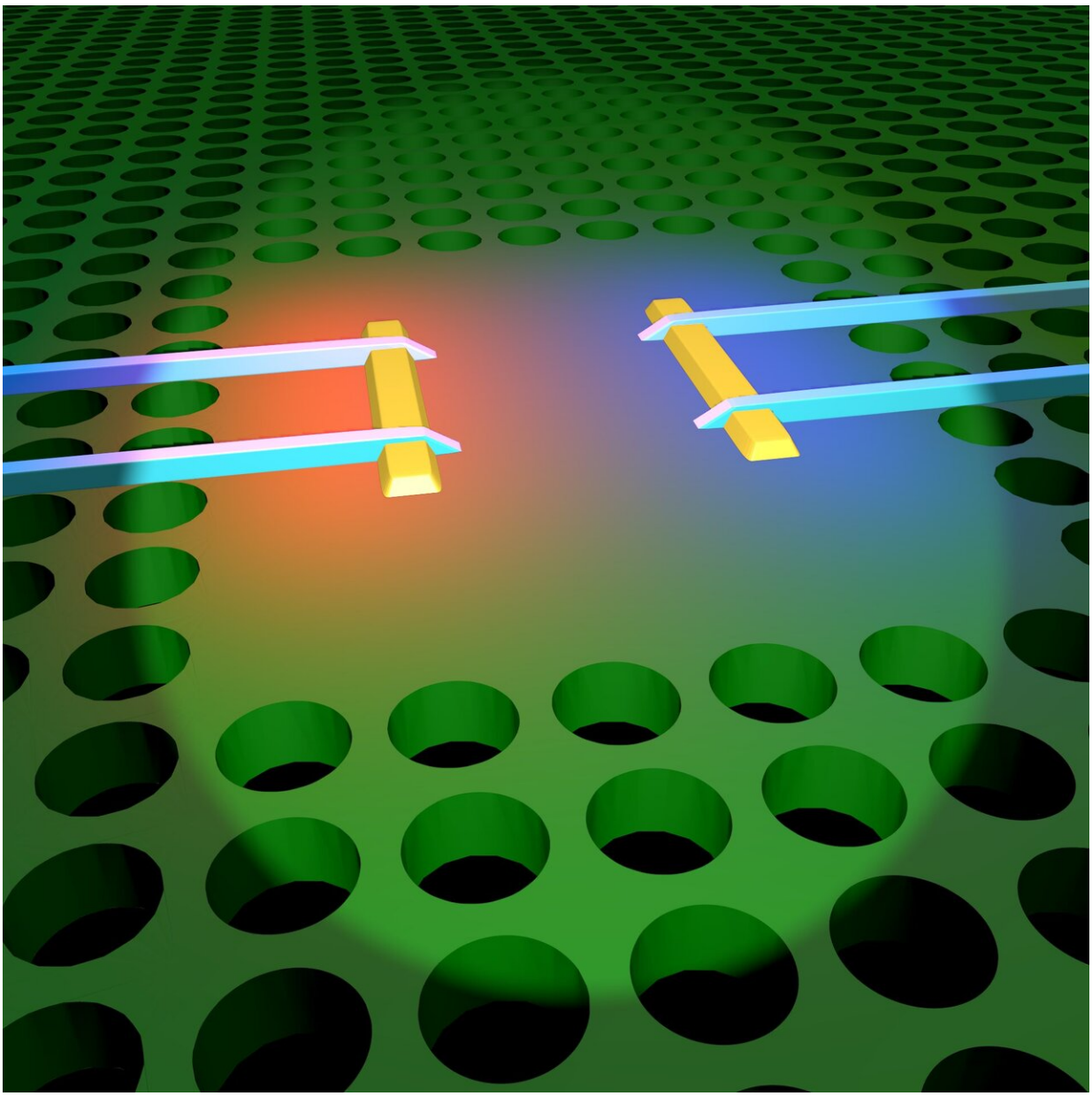

An optimal periodic structure minimizes the thermal conduction to a record low level. Credit: University of Jyvaskyla/ Ilari Maasilta

The group of professor Ilari Maasilta at the Nanoscience Center, University of Jyväskylä specializes on studying how different nanostructures can be used to enhance or impede the transport of heat. The group's latest results, published in the journal *Physical Review Applied* on 3 July, 2019, confirm its earlier observations that by using the wave nature of heat in holey nanostructures heat conduction can be reduced by over hundredfold.

The most important applications of controlling heat transport are in fields such as thermoelectric power conversion and cooling, and bolometric radiation detection.

The holey structures consisted of thin insulating silicon nitride plates containing a periodic array of holes in two directions. In principle, any other material could be used, as well. In particular, the group demonstrated that there is an optimal periodic structure, which minimizes the thermal conduction to a record low level, with a period of about 10 micrometers.

In addition, it was realized that if the hole side surfaces could be fabricated with atomic precision, heat conduction could be reduced even further with larger period structures.

"In the future, we will use these results to improve sensitive infrared radiation detectors for future space research, in collaboration with NASA," says professor Ilari Maasilta from the University of Jyväskyla.

More information: Yaolan Tian et al. Minimizing Coherent Thermal Conductance by Controlling the Periodicity of Two-Dimensional Phononic Crystals, *Physical Review Applied* (2019). DOI: 10.1103/PhysRevApplied.12.014008