Tiny wires a step towards photonic chip

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(PhysOrg.com) -- Australian researchers have engineered one of the world's smallest ever nanowires for the next generation of telecommunication technology, bringing them one step closer to the holy grail of optics – the creation of a 'photonic chip' which would lead to a faster, more sustainable internet.

In a paper published in the journal Nano Letters, researchers from Swinburne University of Technology and the Australian National University, describe how they fabricated a tiny nanowire, which is 1000 times thinner than a human hair, in a special type of glass known as chalcogenide.

According to lead author and Swinburne PhD candidate Elisa Nicoletti, this is a significant step towards the realisation of the photonic chip – the primary goal of the Center for Ultrahigh bandwidth Devices for Optical Systems (CUDOS), a nation-wide collaborative project involving six universities and over 130 researchers. The new result demonstrates the importance of the research collaboration enabled by the ARC Centre of Excellence scheme.

Consisting of countless kilometers of optic fiber cable, the internet is connected by electronic routers. However, these routers work at much slower speeds than the optic cables, which slows the system down. The photonic chip would solve this problem, powering ultra-fast telecommunications networks that transfer information at the speed of light.

But the scientists aren't there yet. The realization of the chip will rely on a range of factors, including the fabrication of extremely small materials and the researchers' ability to harness a unique optical property known as the 'non-linear effect'.

This is where the Australian team's tiny new nanowires come into play.

"In order to make the chip small, every component needs to be extremely small," Nicoletti said. "So we always try to push it that bit further to make our nanostructures as tiny as possible."

Up until now, researchers have only been able to make nanowires of this size in polymers, which don't have the same unique characteristics as chalcogenide glass.

Chalcogenide exhibits non-linearity, which means its optical density changes according to the applied light intensity.

"If you pump high density light into an optic fibre made of non-linear material, you can actually change its properties, and therefore change the way other light moves along it," Nicoletti said

It is this combination of tiny materials and non-linearity, which has brought the researchers one step closer to their ultimate goal.

According to Professor Min Gu, who is Director of Swinburne's Centre for Micro-Photonics and leading the Swinburne arm of CUDOS, the group's success will not only create a much faster internet, it will also lead to a more sustainable one.

"Not many people realise this, but the internet is a major energy consumer. It's projected that in the next decade it will count for half of the world's energy use," he said. "So making it more efficient will make

a huge difference to our carbon footprint."

Provided by Swinburne University of Technology