Train windows that combine mobile reception and thermal insulation

August 29 2016

LESO researchers have conceived an innovative glass that lets mobile phone signals through. Credit: Alain Herzog EPFL

EPFL researchers have developed a type of glass that offers excellent energy efficiency and lets mobile telephone signals through. And by teaming up with Swiss manufacturers, they have produced innovative windows. Railway company BLS is about to install them on some of its trains in order to improve energy efficiency.

Train travel may be fast, but mobile connectivity onboard often lags behind. This is because the modern train car is a metal box that blocks out microwaves – in physics, this is called a Faraday cage. Even the windows contain an ultra-thin metal coating to improve thermal insulation. But EPFL researchers, working with manufacturing partners, have developed a new type of window that guarantees a comfortable temperature for passengers while at the same time letting mobile phone signals through.

In the rail industry, energy use is critical: around one third of the energy consumed by trains goes into providing heating and air conditioning in the train cars. And around 3% of this escapes through the windows. Double-glazed windows with an ultra-thin metal coating increase energy efficiency by a factor of four compared with untreated windows.

But the problem is that the metal sharply weakens the telecommunication signals. The solution that mobile phone operators and railway companies have used until now consists of placing signal boosters – or repeaters – in the trains. But they are expensive to install and maintain and have to be replaced regularly to keep pace with rapidly changing technologies. And each repeater consumes electricity.

A laser-scribed coating

Andreas Schüler, from EPFL's Nanotechnology for Solar Energy Conversion Group, had another idea: "A metal coating that reflects heat waves (which are micrometric in size) but lets through both visible light (which is nanometric in size) and the electromagnetic waves of mobile phones (microwaves, which are centimetric in size)." But how is this done? "We breach the Faraday cage by modifying the metal coating with a special laser treatment. The windows then let the signals through," said Schüler, a specialist in the optical and electronic properties of ultra-thin coatings.

To do this, a special structure is scribed into the metal coating with the aid of a high-precision laser. No more than 2.5% of the surface area of the metal coating is ablated by laser scribing. The resulting pattern is nearly invisible to the naked eye and does not affect the window's insulating properties.

A manufacturing partnership pays off

Initial laboratory tests were extremely convincing. Several manufacturing partners were brought into the team in order to apply the method on a large scale. Thanks to the skills of glassmaker AGC Verres Industriels and the expertise of Class4Laser, prototype glass samples were produced and tested. "Measurements taken by experts from the University of Applied Sciences and Arts of Southern Switzerland (SUPSI) have demonstrated that this works," said Schüler.

Energy savings for BLS

But the innovative glass needed to prove its mettle under real-life conditions. BLS was enthusiastic about testing the new windows as part of ongoing studies aimed at improving the energy efficiency of its trains. The first full-size windows were produced in the AGC Verres Industriels workshop and installed throughout a NINA-type self-propelled regional train.

The field tests met the partners' expectations. Swisscom and SUPSI tested the efficacy of the new windows, both in BLS's workshops and on the Bern-Thun train line. "Mobile reception is just as good in the train through laser-treated insulating glass as it is through ordinary glass," said Schüler.

As a result, BLS has decided to install the new windows in most of its 36

NINA regional trains, replacing the old, non-insulating windows. Installation will begin in September 2016 as part of the company's train modernization program. "Our commitment will help bring to market an innovative product designed to improve the energy efficiency of trains without compromising mobile reception for passengers," said Quentin Sauvagnat, NINA fleet manager at BLS. Thanks to this product, those expensive signal repeaters will no longer be needed.

Are frequency-selective buildings next?

This proven and developed technology could be applied to buildings next. This is because, according to Schüler, "some glass buildings also act like Faraday cages. And as the internet of things continues to grow, there is a real interest in improving the properties of building materials that allow mobile signals through. More broadly, by making materials more frequency-selective, we could, for example, imagine a building that lets electromagnetic waves through but blocks Wi-Fi waves, thus enhancing corporate security."

Provided by Ecole Polytechnique Federale de Lausanne

Citation: Train windows that combine mobile reception and thermal insulation (2016, August 29) retrieved 27 April 2024 from https://phys.org/news/2016-08-windows-combine-mobile-reception-thermal.html