



# Energy towards perfection



*Gallium nitride is the material of the future to prevent wasted energy*

**E**nergy is one of the major challenges for Europe today. The way in which energy is produced and used has a great impact on the economy, the environment and society. Currently, 40% of the energy used in the world is electricity, and it is expected to reach 60% by 2040. This enormous amount of energy not only needs to be produced with a low environmental impact but also to be distributed and used efficiently. These are the requirements of the three-year project “InRel-NPower”, recently launched and coordinated by Professor Gaudenzio Meneghesso of the Department of Information Engineering (DEI), University of Padova, which now boasts twenty years of research into a material that will become crucial in this area: gallium nitride (GaN). “It is the material of the future - begins Meneghesso - many do not realise, but it is already used a lot, for example in Led lamps. The energy challenge needs to be tackled on two fronts: to find new sources with a low environmental impact and to use energy efficiently without wasting it”. The theme of conversion is vital for the latter: today it is estimated that 10% is lost in electric power conversion. “Every time I transform electrical energy from one form to another, I lose a part of it.

On a global scale, you would need 200 nuclear plants to produce the energy that is lost”. To reduce such losses we must create more efficient circuits that use electronic devices made from new materials, because silicon - currently used - has reached its limits. It is now time for GaN: “Gallium and nitrogen are widely available and GaN can be produced on an industrial scale with special chemical reactors”. A material with performances 10 to 100 times higher than silicon, which could result in conversion systems achieving a 99% conversion efficiency. However, it is

a relatively new material (the first transistors were mentioned in literature in 1993): in order to render it a “mature” technology, important steps are still required and these are exactly what the project intends to address. “We work on three parallel levels, in collaboration with 10 partners from different countries. The basic one, is formed by two actions - creating transistors from GaN that reach a sufficient quality to produce robust and reliable circuits, in collaboration with the Belgian companies OnSemi and Epigan and with the University of Ghent; - producing prototypes that demonstrate the true potential of the new devices, involving major industrial partners such as Bosch, Siemens and CE+T. Then, since the material allows it, we want to invent new transistor architectures that provide even greater performance, thanks to the collaboration with the French CNRS. Finally, we intend to change the material and pass to aluminium nitride (AlN), which promises to allow an even greater performance. At this stage we will have the valuable contribution of two Japanese universities, Mie and Kyushu, and the German research institute Fraunhofer”.



**Gaudenzio Meneghesso**

\*THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO 720527\*