



The Challenge

Efficient power conversion systems are at the heart of the worldwide effort for a green economy, since they can minimize losses and save energy. Semiconductor power devices are a central part of any power conversion circuit and are ubiquitous in our daily lives. They transform voltages for a multitude of appliances, for example to convert the DC electricity from an electric car's battery to its AC motor drive.

Highly efficient power switching devices are a key for a sustainable electric energy network. A drastic improvement on the conversion-efficiency can be obtained when implementing wide-bandgap semiconductors instead of silicon.

The *InRel-NPower* project contributes to the world-wide energy challenge through the development of gallium nitride and aluminum nitride -based power devices.

Project Details

Call for proposal: H2020-NMBP-2016-2017
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 Acronym: InRel-NPower
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 EU Contribution: € 7 190 000.00
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11 Partners
 5 Countries
 1 Project



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Innovative **Reliable**
Nitride-based
Power devices and applications

www.inrel-npower.eu



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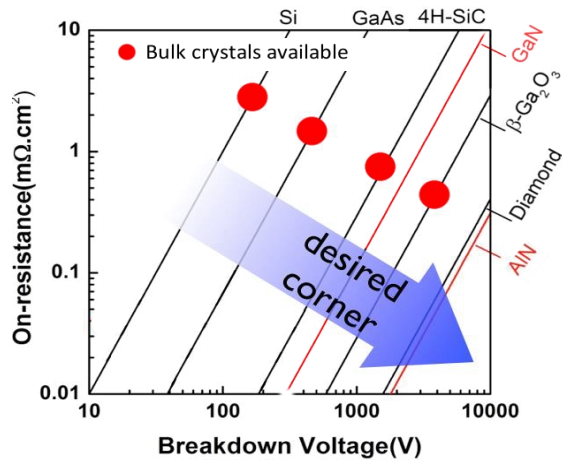
The state of the art

The research and development of power switching devices has made large strides the past decade, and **several key challenges** have been addressed.

To succeed as power devices, the transistors need to exhibit:

- a high breakdown voltage,
- a low on-resistance R_{on} ,
- a low leakage current,
- a positive threshold voltage,
- a high stability and reliability,
- a low production cost.

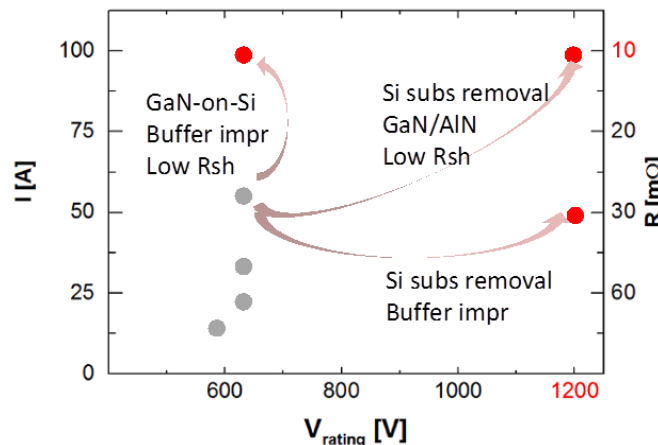
Both GaN and AlN-based devices have great potential in comparison with Si or even SiC devices.



Our Goals

The *InRel-NPower* project's overall objective is to develop robust and reliable GaN and AlN-based power electronics systems. For this, we envision:

- a novel reliability assessment methodology for GaN HEMTs,
- thorough understanding of GaN device lifetime data,
- the exploration of novel architectures such as substrate removal (see figure below),
- innovation in the early development of AlN-substrates for power devices.



Our Ambition

The *InRel-NPower* project aims for:

- GaN devices with $R_{on} < 10\text{m}\Omega$ and breakdown voltage $> 2\text{kV}$,
- the fabrication of AlN devices with even higher breakdown voltage ($> 2.5\text{kV}$) and proven reliability,
- the development of two innovative ultra-low inductance packaging technologies with integrated cooling.

These developments will enable two innovative demonstrators:

- a 20kW **industrial motor drive** with a 60% reduction of power losses and 50% higher power density if compared with state-of-the-art Si-based inverters,
- a **DC to AC converter** (2kW, 230V) with peak efficiency up to 99% and an expected lifetime of minimum 10^6 hours.

If successful, the project will result in a substantial boost in competitiveness of reliable GaN devices.

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