

**Will the gallium
nitride (GaN) crystal
soon change everything
thanks to **the success
of Ammono company?****

Ammono is passion,
courage and conviction
about the effectiveness
of carrying out
the **project in Poland**

Before founding the company

Mariusz Blimel: How was the idea for the company born? Where did the grain come from and how did it germinate?

Robert Dwiliński: Already during my Master's studies, it appeared to me that not only was physics interesting in itself, but also the knowledge could generate some serious benefits for the human being. It was then that I began to wonder what useful things could be done with the use of knowledge in the area of physics. My first choice was solid-state physics, which allows for creating various materials. Then, I found out that the Department of Solid-State Physics was strongly focused on semiconductors, precisely semiconductor crystals. That is how the question appeared: which crystals and how can they be used? During one of the seminars led by Iza Grzegory (now the Director of the Institute of High Pressure Physics of the Polish Academy of Sciences), I had a sudden thought that materials based on nitrides of group three metals: gallium, aluminium and indium nitrides may have a huge use for many various devices. That was how the idea to produce and sell such semiconductors as a commercial product came into being. It turned out that the potential possibilities of such a material were fantastic and that it was not available on the market. We thought that if we managed to produce such a crystal, there would be a real possibility to transform this invention into some business related to it. Gallium nitride became the subject of my Ph.D. dissertation, which began with searching for method of crystallising gallium nitride and then proceeded to studying the properties of the obtained crystals, which was supposed to show something interesting for the development of physics. We were examining several different methods in several teams and one of them appeared to be exceptionally promising. I decided to study the method with my friends whom I had known since primary school and with whom I used to study. As a result, our team

consisted of an experimental physicist, a theoretical physicist and two chemists (including one with huge experience in building chemical apparatus and large scale chemical processes). We also had good understanding and relations thanks to which our team has already been cooperating for 18 years. We were doing pioneer research so we had a long way to go before founding the company. These were the years from 1992 to 1998. Then came the moment when the results we obtained appeared to be promising and required re-

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search on a larger scale, i.e. a huge number of research processes in repeatable, controlled conditions. Such industrial research could not be carried out in university laboratories. That was how the idea of founding the company was born.

The beginning

Leszek Sierzputowski: We come almost from the same neighbourhood (Warsaw Powiśle) and all of us attended the same primary school. Then we stayed in touch thanks to scouting and other interests. Two of us studied Physics at the University of Warsaw and two studied Chemistry at the Warsaw University of Technology. After studies, we worked together on the synthesis process of gallium nitride (GaN) in supercritical ammonia (ammonothermal method) within grants carried out in the Department of Solid-State Physics of the Institute of Experimental Physics at the University of Warsaw. Following the establishment of Ammono Sp. z o.o., we have been developing the process of GaN crystallisation. At the beginning, we were able to produce small crystals the size of coarse-grained salt.



photo: Mariusz Blimeł

We established our economic activity in late 1990s

The creators of Ammono

L.S.: Ammono was created by Robert Dwiliński - a physicist, who became interested in the production of gallium nitride already during his studies, Leszek Sierpurowski - an expert specialising in chemical processes, Roman Doradziński - a specialist on thermodynamic calculations, Jerzy Garczyński - specializing in growth processes in high-pressure conditions.

There was research and there is a company

L.S.: We established our economic activity in late 1990s. That was a difficult period as regards the economy in Poland, which significantly reduced the possibilities of our company's development. We seemed not to stand any chance. However, the idea was not to give up in spite of many adversities and to fight for the survival of the company.

Nakamura and Nichia

R.D.: Therefore, I began to write letters to many people whom I had met during conferences and whom I knew to have been interested in the problem. I sent the information about our research e.g. to Japanese Nichia Corporation, which is still the leader as regards optoelectronics based on gallium nitride. At that time, the famous Nakamura was working there, the inventor of the blue laser and the first blue and white diodes, the man who opened the door for nitride electronics. He was the man of huge technical genius so he quickly picked up the idea I had briefly presented to him. He wrote back that he would like to come and see it. He got on the plane and came here from Japan. He thought it was a brilliant idea which had to be carried out immediately. Thus, it was him who convinced Nichia to join us in a research project. Although the first idea was to transfer us to Japan, we managed to persuade everybody we would carry out the project more effec-

tively in Poland than anywhere else. It is here that we feel more comfortable and have better access to technical resources. The project was so interesting for the Japanese that they agreed to accept this condition. We signed an agreement which guaranteed financing of our further research by the Japanese and established our co-ownership of patents. The project had been carried out for several years until the Japanese decided that the research part was finished and we should proceed to the commercial part. That was the time to start producing the material which they were willing to buy. Therefore, we are trying to develop the production now. The Japanese, in spite of having financed a significant part of the research and having a minority interest in the company, do not invest in such ventures. Although they are interested in purchasing the product, we are not able to obtain any more money from them for production.

A growing number of gallium nitride plates increasing in size

R.D.: Currently, we are looking for possibilities of financing for the production part of our venture. Therefore, we have various ideas such as New Connect, etc. We are now in the stage of developing our productive power in order to produce more material and larger plates. The scale of production for commercial use is enormous.

When I decided to study Physics, I had no idea to what extent this field of study would allow me to create something useful for our civilization. It just seemed to be an interesting subject to study.

Future with gallium nitride

R.D.: We are currently producing almost clear crystals, the longest side of which is over 54 millimetres. During the next few months, Ammono will have so many of them that we will be able to start cutting them into slices and arranging them into round substrates on which semiconductors will be placed.

The market of gallium nitride substrates is valued at 200 million dollars annually. However, there is a huge perspective of growth and, in the near future, we mi-

ght expect the market to be worth, if not more than ten, at least several billion dollars.

Our aim is to produce larger crystals as, then, their use will be more universal. I mean here integrated circuits because gallium nitride is a better conductor than silicon. The use in lighting as well as in car industry might appear to be a real revolution and future for gallium nitride.

L.S.: The use of gallium nitride plates in motor indu-

The use of gallium nitride plates in motor industry, i.e. in electrically driven cars.

stry, i.e. in electrically driven cars. One car will consume a four-inch plate. The potential is such that we could produce and sell 1,600,000 pieces. That creates the market of 8 billion dollars. A great future is the use of gallium nitride in lighting as it is, currently, the most effective material for processing the electric current. It must be noticed that the human being uses 30% of the whole energy for lighting purposes. Gallium nitride is much more efficient than traditionally used fluorescent lamps and, which is incredibly important, it is a product harmless for the environment. Using our potential to the maximum, we will not be able to produce such huge amounts of the material that will be required. We are looking for solutions which would allow us to multiply the production method used by us.

Niche and fight for customers

We now have crystals with the length of over 50 millimetres, *which are perfect for laser production*. Thus, we are fighting for the ready market, which is not such an easy and obvious thing as it could seem. Firstly, in order to introduce a certain crystal into production, it has to undergo a series of tests and studies in laboratories of potentially interested concerns in electronic industry. Such tests are expensive and extended in time. Thus, we are waiting for positive results of laboratory tests, which will result in an interest in using gallium nitride directly in production. A single crystal suitable for laser production costs about 5,000 dollars. Our crystals, being clearer and cheaper, are definitely better.