

The discovery of lithium-ion cells was a major technological breakthrough and has led to the shaping of the world in which mobile computers, smartphones, electric cars and other energy-intensive mobile devices are an everyday reality. This technology is also playing its part in the energy transition – large-scale battery packs are being developed to store excess electricity produced by renewable power sources. The electricity stored in this way can then be used during so-called *dunkelflaute*, days when weather conditions make it much more difficult to obtain energy from the sun or wind. However, due to the limited supply of lithium in the Earth's crust, scientists have begun searching for a technology that would be capable of replacing lithium-ion batteries. Sodium-ion batteries, which have the same operating principle and design as their lithium-based counterparts, may prove to be an alternative. Sodium is a much more common element than lithium, which would translate into a significantly lower price for sodium-ion cells compared to lithium-ion batteries. It is also distributed much more evenly in the Earth's crust, which would allow countries such as Poland, where lithium resources are minimal, to become at least partially independent of imports for the production of such cells. However, due to the significantly higher mass of the sodium cation relative to the lithium cation and the higher redox potential of the  $\text{Na}^+/\text{Na}^0$  pair compared to  $\text{Li}^+/\text{Li}^0$ , the energy density of sodium-ion cells is lower, which is associated with the higher mass of sodium-ion batteries relative to their lithium-ion counterparts with similar parameters. For this reason, further work on the development and optimization of this technology is advisable.

Sodium-iron phosphates with the formula  $\text{NaFePO}_4$  are potential candidates for positive electrode materials in sodium-ion cells. Their incredible advantage is low cost and low toxicity. Previous research indicates that the most promising form in which this material exists is that with an amorphous structure. This project concerns the optimization of the synthesis of amorphous  $\text{NaFePO}_4$  in order to obtain the best possible performance in a sodium-ion cell. The next stage of the research will be to further improve their properties by doping with cations of other metals such as manganese, nickel, vanadium, zinc, copper, magnesium, calcium or potassium. The goal will be to improve parameters such as operating voltage, specific capacity, resistance to subsequent charge/discharge cycles and to operation at high currents. This will result in obtaining materials with higher energy density and stability of operation compared to undoped sodium-iron phosphates, thereby increasing the commercialization potential of such compounds.