Miniaturization is one of the key aspects of modern technology, enabling devices to become increasingly smaller, more efficient, and versatile. To fit more components within limited space, manufacturers face numerous technological challenges, including efficient heat dissipation, reducing energy consumption, enhancing the functionality of resulting systems, and implementing precise manufacturing methods. Moreover, the downsizing of devices must be safe and sustainable by design.

Meeting the ever more demanding goals of miniaturization relies on the exploration of materials with unique properties. An excellent example of such a material is boron phosphide (BP) **-** a binary compound where boron and phosphorus atoms form an ordered network of covalent bonds, preventing the distinction of individual molecules. Due to this structure, boron phosphide exhibits remarkable chemical and physical properties: it has a diamond-like crystal structure, giving it high hardness, and demonstrates exceptional resistance to high temperatures, aggressive chemicals, and corrosion, which significantly increases the spectrum of its possible technology applications. BP is also a semiconductor material with ultra-high thermal conductivity, making it an ideal candidate for applications in electronics, optoelectronics, and photovoltaics (in solar cells, displays, diodes), and high thermal conductivity materials. The properties of boron phosphide also make it considered as potential material in spintronics and nanotechnology. Its photocatalytic capabilities are also promising for splitting water into hydrogen and oxygen under sunlight **-** a future-proof method of producing hydrogen, a fuel of great importance to the energy economy.

However, the practical use of boron phosphide is limited by the drawbacks of current synthesis methods. These methods are complex, costly, and inefficient, often yielding impure products. Nevertheless, boron phosphide remains an extremely intriguing material with unique properties and a broad range of potential applications. Further research and investment are necessary for the continued development of these technologies.

The scientific goal of this project is to develop an innovative method for molecular boron phosphide synthesis in the form of L-BP-L adducts. These systems will be stabilized by carefully selected ligands (L), such as donor-acceptor ligands with frustrated Lewis pair properties and donor N-heterocyclic carbene ligands. This strategy builds upon previous successful and described in the literature applications of such ligands for stabilizing B_2 and P_2 molecules. The next step of the project involves studying the chemical properties of the obtained adducts through their reactions with small organic and inorganic molecules. Additionally, it is anticipated that these adducts will act as precursors for the controlled release of boron phosphide molecules through thermal decomposition in solution, ultimately enabling the formation of thin BP layers on metals or silicon. As a result, this project will make a significant contribution to the development of methods for obtaining high-quality, pure materials based on binary phosphides, opening new prospectives not only in chemical synthesis but also in materials engineering. Stabilizing boron phosphide molecules under mild conditions could become a breakthrough in the production of functional materials with tailored properties that will find wide application in advanced technologies.