Hexagonal boron nitride (h-BN) is a two-dimensional wide bandgap semiconductor with a crystal structure similar to graphene – boron and nitrogen atoms are arranged in honeycomb layers stacked one above the other. Atoms in one plane are connected by strong covalent bonds while subsequent layers only interact via weak van der Waals forces. Therefore, it is possible to obtain very thin layers of h-BN (even layers of thickness of one single atom), which nowadays are commonly used by scientists in so-called van der Waals heterostructures. h-BN has a bandgap of about 6 eV which corresponds to light emission in the deep ultraviolet (UV), so this material bears great hope for future applications also in this spectral range.

However, h-BN, like all other crystals, has some defects in its crystal structure (e.g. the lack of some atoms, or the presence of atoms other than B or N). Such **defects can result in the existence of energetic states within the bandgap**. A few years ago it has been reported that some of these **defect-related states in h-BN are single-photon emitters (SPEs) at room temperature**. It means that only one photon of particular energy (quantum of light) can be emitted in a short period of time. This discovery increased the interest in h-BN since SPEs can be used as qubits (quantum bits) in quantum computing and quantum cryptography. The development of these areas will improve data transfer safety because the information encrypted with quantum methods is impossible to read for other people using classical methods. Furthermore, the application of quantum methods may increase the speed of data processing which can lead to faster progress in many scientific areas such as physics, chemistry and biology, which often use complicated mathematical simulations.

Latest scientific reports indicate the crucial role of deformations of h-BN layers such as wrinkles or bubbles. **At points where h-BN is strongly curved, SPEs can be activated** due to the deformation potential which can trap carriers. It has also been shown that the energy of the emitted light can be tuned by strain. Therefore, strain, which is induced near a deformation, can both activate and tune single-photon emission in h-BN to a specific energy. Although single-photon emission from h-BN is a hot topic for researchers around the world, many research groups work with h-BN flakes exfoliated from commercially available bulk crystals or with h-BN powders. Such material suffers from a lack of reproducibility. Therefore, although researchers can study if an induced deformation activates single-photon emission in their particular h-BN sample, they cannot find clear and unambiguous answers which way of SPEs activation is the best in order to obtain quantum light emission of specified properties. Such answers are difficult to find by comparing different activation methods for h-BN samples of different properties.

In this proposal, **we aim to deterministically create h-BN deformations to activate single-photon emission**. Defect formation can be achieved in many ways. One approach that we propose is to irradiate the surface of the h-BN layer with an electron beam which yields h-BN bubbles. Our initial results show that we are able to deterministically create bubbles and change their shapes by varying the ambient pressure. We also show that we can study the strain distribution of these bubbles by micro-Raman spectroscopy mapping. Another method is using lithography to obtain predetermined h-BN structures. Different mechanisms can also be applied together. Moreover, with our approach, it is possible to create matrices of deformations which repeat periodically, which is important in terms of possible future industrial applications. Contrary to other groups, we work with our reproducible h-BN grown on large-area 2-inch substrates by metalorganic vapour phase epitaxy (MOVPE) at the Faculty of Physics, University of Warsaw. Since the same growth conditions yield h-BN layers of the same properties, we can study how deformations obtained by different methods affect single-photon emission from identical samples by using optical spectroscopy. **Some properties of such deformations** (e.g. size of the bubble or distance between deformations) **can be optimized** in order to achieve single-photon emission of predetermined properties. The results of our project may pave the way to control the properties and spatial positions of SPEs in h-BN on industrial relevant large-area h-BN epilayers, which is of great importance for future facile integration with dedicated photonic structures.